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DISTRIBUTION UNLIMITED **AFPTEF PROJECT NO. 05-P-102**

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Development of the C-17 Fan Thrust Reverser Container, *CNU-688/E*

AFMC LSO/LOP
AIR FORCE PACKAGING TECHNOLOGY & ENGINEERING FACILITY
WRIGHT PATTERSON AFB, OH 45433-5540
October 2006

NOTICE

AFPTEF PROJECT NO. 05-P-102
TITLE: Development of the C-17 Fan Thrust Reverser Container

ABSTRACT

The Air Force Packaging Technology and Engineering Facility (AFPTEF) was tasked with the design of a new shipping and storage container for the C-17 Fan Thrust Reverser (FTR) in March of 2004. The new container is designed to replace the wood crate and wood frame assembly presently used.

The current containers' lack of mechanical protection, environmental protection, handling issues, and left and right container requirements prompted AFPTEF's design of a new container. The new container will protect the FTR both mechanically and environmentally, hold either the left or right FTR, and make it easier to maneuver during worldwide shipment and storage. The CNU-688/E, designed to SAE ARP1967A, is an aluminum, long-life, controlled breathing, reusable shipping and storage container. The new container passed all qualification tests per ASTM D4169.

The CNU-688/E container not only meets users' requirements but will also provide an economic saving for the Air Force. The savings will be thousands of dollars over the twenty-year life span of the container.

Total man-hours: 440

PROJECT ENGINEER:

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TEST ENGINEER:

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INTRODUCTION

BACKGROUND – The C-17 Sustainment group (564 ACSS/GFL) located at Robins AFB requested the Air Force Packaging Technology and Engineering Facility (AFPTEF) develop a long-life aluminum container for the C-17 Fan Thrust Reverser (FTR). The container is a replacement for the current wood crate with a wood frame/cradle structure which provides very little shock, vibration, or environmental protection. The current packaging degrades readily during use and can not be stored outside. The new FTR container is one of a family of new AFPTEF container designs to protect C-17 items that are being damaged in the shipping and storage cycle. Containers were also designed for the main landing gear (MLG) axle beams, MLG posts, full MLG assemblies, nose landing gear assembly, nose radome, brake assembly, OBIGGS winch, and heads-up display unit.

REQUIREMENTS – AFPTEF, Boeing, and Robins AFB personnel agreed upon a list of requirements during initial design discussions. Many of these requirements were not being met by the current wood crate. The requirements are as follows:

- Sealed/controlled-breathing container that protects against varied environmental conditions and weather during either inside or outside shipping and storage
- One container design for both the left and right models
- No loose packing material
- Shock/Vibration limited to 50 Gs
- Reusable and designed for long life (20 years)
- Low maintenance
- Field repairable hardware
- Forklift capabilities

DEVELOPMENT

DESIGN – The C-17 FTR Shipping and Storage Container (CNU-688/E) design meets all the users' requirements. The CNU-688/E is a sealed, welded aluminum, controlled breathing, reusable container. The container is engineered for the physical and environmental protection of the FTR during worldwide transportation and storage. The container consists of a low profile base and a completely removable cover (see Appendix 2, Figure 1) equipped with the special features listed below. Guide posts (see Appendix 2, Figures 1 & 2) keep the cover from swinging into the FTR during cover removal and replacement. The base is a one piece skid/double-walled base extrusion with 4-way forklift openings, humidity indicator, pressure equalizing valve (1.0 psi pressure/ 1.0 psi vacuum) and desiccant port for easy replacement of desiccant (controls dehumidification). A silicone rubber gasket and quick release cam-over-center latches create a water/air-tight seal at the base-cover interface. Container external dimensions are 118.6 inches in length, 115 inches in width, and 112.6 inches in height. Container tare weight is 2716 pounds, and 3965 pounds with a FTR in place.

An aluminum cradle/frame system is integrated into the container base suspended on fourteen stainless steel helical isolators that provide shock and vibration protection to 50 G's (see Appendix 2, Figures 2 & 3). The FTR is attached to the cradle/frame system at the top by placing special quick pins through a u-shaped block (see Appendix 2, Figures 4 & 5) and at the bottom with four adjustable turnbuckles (see Appendix 2, Figure 6). These FTR attachment points are the same points where the FTR attach to the aircraft. The cradle/frame system is adjustable to hold either the left or right FTR. The cradle/frame system allows easy loading and unloading with the use of the field sling (see Appendix 2, Figure 7).

In addition to the FTR, there are additional parts such as hoses and clamps that also must be shipped in the container. This compartment is located between the isolator supports of the cradle/frame system on the forward end of the container (see Appendix 2, Figure 8). The compartment is made of aluminum channels lined with polyethylene foam and have hinged covers to keep the parts organized and secure during transportation. There are no detachable parts on the container other than the cover, which eliminates FOD risks.

Certain information has to be verified on each FTR prior to shipment. To avoid removing the cover to obtain this information a series of special viewing ports were installed in the container side walls at strategic locations to obtain the desired information (see Appendix 2, Figures 9 & 10).

C-17 FTR CONTAINER FEATURES	
Pressure Equalizing Valve	3
Humidity Indicator	1
Desiccant Port	1
Document Receptacle	1
Viewing Port	4
Observation Windows	8
Forkliftable	Yes
Cover Latches	28
Cover Lift Handles	None
Cover Lift Rings	4
Cover Tether Rings	4
Base Lift Handles	None
Base Tie-down Rings	8
Stacking Capability	No

PROTOTYPE – AFPTEF fabricated one CNU-688/E prototype container in house for testing. The prototype container was fabricated in accordance with (IAW) all requirements and tolerances of the container drawing package. The drawing package used for prototype fabrication has been released for the manufacture of production

quantities of the container. Each face of the container was uniquely identified for testing identification as shown below.

DESIGNATED SIDE	CONTAINER FEATURE
Top	Cover Top
Aft	Desiccant Port
Right	Right Side from Aft
Left	Left Side from Aft
Forward	Opposite Aft
Bottom	Base Bottom

QUALIFICATION TESTING

TEST LOAD – The test loads were unserviceable left and right FTR units. A triaxial accelerometer, used to record actual accelerations sustained by the FTR, was mounted on the test load as close to the center of mass as possible (see Appendix 2 Figure 11). The test load weight was 1249 lbs.

TEST PLAN – The test plan primary references were ASTM D 4169 and SAE ARP 1967 (see Appendix 1). The test methods specified in this test plan constituted the procedure for performing the tests on the FTR container. The performance criteria for evaluation of container acceptability were specified at 50 Gs maximum and an initial and final leak rate of 0.34 kPa (0.05 psi) per hour at 6.9 kPa (1.0 psi). These tests are commonly applied to special shipping containers providing rough handling protection to sensitive items. The tests were performed in December 2005 and January 2006 at AFPTEF, Building 70, Area C, Wright-Patterson AFB.

ITEM INSTRUMENTATION – The test load was instrumented with a piezoelectric triaxial accelerometer mounted as close as possible to the antenna's center of mass at approximately a 45° angle. Accelerometer axis orientations were as follows:

X Axis - Directed through container Left and Right sides .
Y Axis - Directed through container Forward and Aft.
Z Axis - Directed through container Top and Bottom sides (Vertical motion).

See Appendix 4 for detailed accelerometer and other instrumentation information.

TEST SEQUENCES – Note: All test sequences were performed at ambient temperature and humidity, unless otherwise noted in the test procedure. All procedures, except for Test Sequences 1, 8 & 9, were performed on the container first using the left FTR, and repeated using the right FTR.

TEST SEQUENCE 1 – Leak Test

Procedure – The desiccant port cover was removed and replaced with a port cover modified for attachment of the digital manometer and vacuum/pressure pump lines. The container was closed and sealed. The leak test was conducted at ambient temperature and pressure. The pneumatic pressure leak technique was used to pressurize the container to a minimum test pressure of 6.9 kPa (1.0 psi). Maximum allowable leak rate is 0.34 kPa (0.05 psi) per hour. (see Appendix 2, Figure 12).

Results – The container passed the leak test with a leak rate less than the maximum allowed rate of 0.34 kPa (0.05 psi) per hour.

TEST SEQUENCE 2 – Vibration Test, Resonance Dwell

Procedure – This test could not be performed due to container size.

TEST SEQUENCE 3 – Loose Load Vibration, Repetitive Shock

Procedure – This test could not be performed due to container size.

TEST SEQUENCE 4 – Rotational Drops

Procedure – An Assurance Level I drop height of 305 mm (12 in.) was used to perform four corner and four edge drops onto a smooth concrete surface, the impact levels were recorded. The maximum allowed impact level for the FTR was 50 Gs. (see Appendix 2, Figures 13 & 14.)

Results – All recorded impacts were less than the maximum allowed 50 Gs for both left and right FTRs. There was no damage to either the container or the item. The container met the test requirements. (see Appendix 3, Table 1 and Corner and Edge Drop Waveforms.)

TEST SEQUENCE 5 – Leakage Test

Procedure – Test Sequence 1 was repeated.

Results – The container passed the leak test with a leak rate less than the maximum allowed rate of 0.34 kPa (0.05 psi) per hour.

TEST SEQUENCE 6 – Lateral Impact (Pendulum Impact)

Procedure – Upon completion of the rotational drops, the container was placed on the pendulum test apparatus and impacted once on each side and end. The container impact velocity was 2.2 m/sec. (see Appendix 2, Figure 15.)

Results – All recorded impacts were less than the maximum allowed 50 Gs for both left and right FTRs. There was no damage to either the container or the item. The container met the test requirements. (see Appendix 3, Table 1 and Lateral Impact Waveforms.)

TEST SEQUENCE 7 – Leakage Test

Procedure – Test Sequence 1 was repeated.

Results – The container passed the leak test with a leak rate less than the maximum allowed rate of 0.34 kPa (0.05 psi) per hour.

TEST SEQUENCE 8 – Vacuum Retention Test

Procedure – The desiccant port cover was removed and replaced with a port cover modified for attachment of the digital manometer and vacuum/pressure pump lines. The container was closed and sealed. The vacuum retention test was conducted at ambient temperature and pressure. The air inside the container was evacuated to a minimum test vacuum of -6.9 kPa (-1.0 psi). Maximum allowable pressure increase rate is 0.34 kPa (0.05 psi) per hour.

Results – The container passed the vacuum retention test with a pressure increase rate less than the maximum allowed rate of 0.34 kPa (0.05 psi) per hour.

TEST SEQUENCE 9 – Leakage, Design Test

Procedure – This test was performed following all other testing for both the left and right FTRs. The desiccant port cover was removed and replaced with a port cover modified for attachment of the digital manometer and vacuum/pressure pump lines. The container was closed and sealed. The leak test was conducted at ambient temperature and pressure. The pneumatic pressure leak technique was used to pressurize the container to a minimum test pressure of 17.1 kPa (2.5 psi). Deflection of the sides was measured, and the pressure released to the Leakage Test requirement of 6.9 kPa (1.0 psi) and the leakage rate recorded. The container must be able to meet the leak test requirements of Test Sequences 1 upon completion of this test. (See Appendix 2, Figure 16.)

Results – The container passed the design leakage test with no structural damage. Maximum side deflection was approximately 2 inches along the forward and aft sides. The container met the leak test requirements of 0.34 kPa (0.05 psi) per hour upon completion of this test.

TEST CONCLUSIONS – No damage occurred during the above testing to the container, isolation system or test item. All impact levels are well below the item fragility limit of 50 Gs. Therefore, the container and mounting system do provide adequate protection for the FTR.

FIT AND FUNCTION

Fit and function testing was completed on site at AFPTEF with the non-serviceable FTR's. The packaging process was demonstrated by Boeing and AF personnel at Charleston AFB using fielded FTRs.

CONCLUSIONS

The CNU-688/E aluminum container passed all tests and was accepted by the users at Charleston AFB. The container met all the user's requirements. The container can protect a FTR during world-wide transportation and storage. The container will save the Air Force hundreds of thousands of dollars in O&M costs.

RECOMMENDATIONS

AFPTEF recommends that the new containers be procured and delivered as needed to avoid future damage, thus mitigating overall shipping risks. All wood crates for the FTR should be replaced.

APPENDIX 1: Test Plan

AF PACKAGING TECHNOLOGY AND ENGINEERING FACILITY (Container Test Plan)

AFPTEF PROJECT NUMBER: 05-P-102

CONTAINER SIZE (L x W x D) (MILLIMETERS) INTERIOR:	EXTERIOR:	WEIGHT (Kgs) GROSS:	ITEM:	CUBE (CU.M)	QUANTITY:	DATE:
2821 X 2410 X 2810	2911 X 2900 X 298.3	1800	588	21.7	1	5 Oct 06

ITEM NAME: C-17 Fan Thrust Reverser (FTR)

MANUFACTURER:

CONTAINER NAME: C-17 FTR Reusable Shipping & Storage Container

CONTAINER COST:

PACK DESCRIPTION: Extruded Aluminum Cntr., Aluminum Cradle, Helical Isolators, Test Load of a C-17 FTR

CONDITIONING: As noted below

TEST NO.	REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S	TEST TITLE AND PARAMETERS	CONTAINER ORIENTATION	INSTRU-MENTATION
		NOTE No damage to contents is acceptable and Package must be in serviceable condition. Serviceable means remains sealed, with no deformities, etc.		
		Quality Conformance Tests		
1.	**Examination of Product.**			
	SAE ARP 1967 Par. 4.5.1 Table I	Container shall be carefully examined to determine conformance with material, workmanship, and requirements as specified in Table and drawings.	Ambient temp.	Visual Inspection (VI)
2.	**Weight Test.**			
	SAE ARP 1967 Par. 4.5.8.3.7	Container shall be weighed.	Ambient temp.	Scale
		Performance Tests		
3.	**Leak Test.**			
	SAE ARP 1967 Par. 4.5.2	Pneumatic pressure at 6.9 kPA (1.0 psi) and vacuum retention at -6.9 kPA (1.0 psi). After temperature stabilization, pressure drop shall not exceed 0.34kPA (0.05 psi) per hour. Test shall last a minimum of 30 minutes.	Ambient temp.	Water Manometer (WM) or Pressure Transducer (PT)

COMMENTS:

PREPARED BY: Mark W. Boals, Mechanical Engineer

APPROVED BY: Robbin L. Miller, Chief AFPTEF

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AF PACKAGING TECHNOLOGY AND ENGINEERING FACILITY
(Container Test Plan)

AFPTEF PROJECT NUMBER: 05-P-102

CONTAINER SIZE (L x W x D) (MILLIMETERS) INTERIOR:	EXTERIOR:	WEIGHT (Kgs) GROSS:	ITEM:	CUBE (CU. M)	QUANTITY:	DATE:
2821 X 2410 X 2810	2911 X 2500 X 2983	1000	568	21.7	1	5 Oct 06

ITEM NAME: C-17 Fan Thrust Reverser (FTR)
MANUFACTURER:

CONTAINER NAME: C-17 FTR Reusable Shipping & Storage Container
CONTAINER COST:

PACK DESCRIPTION: Extruded Aluminum Cntr., Aluminum Cradle, Helical Isolators, Test Load of a C-17 FTR

CONDITIONING: As noted below

TEST NO.	REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S	TEST TITLE AND PARAMETERS	CONTAINER ORIENTATION	INSTRU-MENTATION
4.	**Vibration Test.**			
a.	**SAE ARP 1967 Par. 4.5.5 ASTM D 4169 ASTM D 999**	The container shall be vibrated from 5 Hz to 50 Hz at a sweep rate of one half octave per minute with a total sweep time of 7.5 minutes. Container shall then be vibrated for 30 minutes at the predominant resonance. Input excitation shall be 0.125 in double amplitude or 1 G limits.	Ambient temp. Rigidly attach container to exciter	VI Tri-axial Accelerometer
b.	**SAE ARP 1967 Par. 4.5.5 ASTM D 4169 ASTM D 999**	Container shall be vibrated IAW ASTM D 4169, Method D 999 for not less that two hours.	Ambient temp. Blocking shall be used to keep cntr. in place, do not restrict vertical or rotational movement	VI Tri-axial Accelerometer
5.	**Rotational Drop Tests (Ambient Temperature).**			
	SAE ARP 1967 Par. 4.5.3 ASTM D 4169 ASTM D 6179 Methods A&B	Drop height shall be 305mm (12"). Item shall not sustain more than 50G's.	Ambient temp. One drop on all bottom corners (4 drops) and one drop on all edges (4 drops).	VI Tri-axial Accelerometer
6.	**Lateral Impact Test (Ambient Temperature).**			
	SAE ARP 1967 Par. 4.5.6 ASTM D 4169 ASTM D 880 Procedure B	Impact velocity 2.23 m/sec. (7.3 ft/s). Item shall not sustain more than 50G's.	Ambient temp. One impact on each end and one on each side (4 impacts).	VI Tri-axial Accelerometer

COMMENTS:

PREPARED BY: Mark W. Boals, Mechanical Engineer
APPROVED BY: Robbin L. Miller, Chief AFPTEF

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AF PACKAGING TECHNOLOGY AND ENGINEERING FACILITY
(Container Test Plan)

AFPTEF PROJECT NUMBER: 05-P-102

CONTAINER SIZE (L x W x D) (MILLIMETERS) INTERIOR:	EXTERIOR:	WEIGHT (Kgs) GROSS:	TARE:	CUBE (Cu. M)	QUANTITY:	DATE:
2921 X 2410 X 2610	3911 X 2500 X 2983	1800	568	21.7	1	5 Oct 06

ITEM NAME: C-17 Fan Thrust Reverser (FTR)
MANUFACTURER:
CONTAINER NAME: C-17 FTR Reusable Shipping & Storage Container
CONTAINER COST:
PACK DESCRIPTION: Extruded Aluminum Cntr., Aluminum Cradle, Helical Isolators, Test Load of a C-17 FTR
CONDITIONING: As noted below

TEST NO.	REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S	TEST TITLE AND PARAMETERS	CONTAINER ORIENTATION	INSTRU-MENTATION
7.	**Leak Test.**			
	SAE ARP 1967 Par. 4.5.2	Pneumatic pressure at 6.9 kPa (1.0 psi). After temperature stabilization, pressure drop shall not exceed 0.34 kPa (0.05 psi) per hour. Test shall last a minimum of 30 minutes. Vacuum retention at -6.9 kPa (-1.0 psi). After temperature stabilization, pressure increase shall not exceed 0.34 kPa (0.05 psi) per hour. Test shall last a minimum of 30 minutes.	Ambient temp.	Water Manometer (WM) or Pressure Transducer (PT)
8.	**Leakage Design Test.**			
	SAE ARP 1967 Par. 4.5.2.3	Pressurize to 17.1 kPa (2.5 psi). No component shall fail, measure deflection. Reduce pressure to 6.9 kPa (1.0 psi). After temperature stabilization, pressure drop shall not exceed 0.34 kPa (0.05 psi) per hour. Test shall last a minimum of 30 minutes.	Ambient temp.	Water Manometer (WM) or Pressure Transducer (PT)

COMMENTS:

PREPARED BY: Mark W. Boals, Mechanical Engineer
APPROVED BY: Robbin L. Miller, Chief AFPTEF

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APPENDIX 2: Fabrication & Testing Photographs

Figure 1. Completely removable cover, shows four point lift to single apex and tether points for guiding cover off and on.

Figure 2. FTR attached to new aluminum cradle/frame system.

Figure 3. Cradle/Frame system suspended on stainless steel helical isolators.

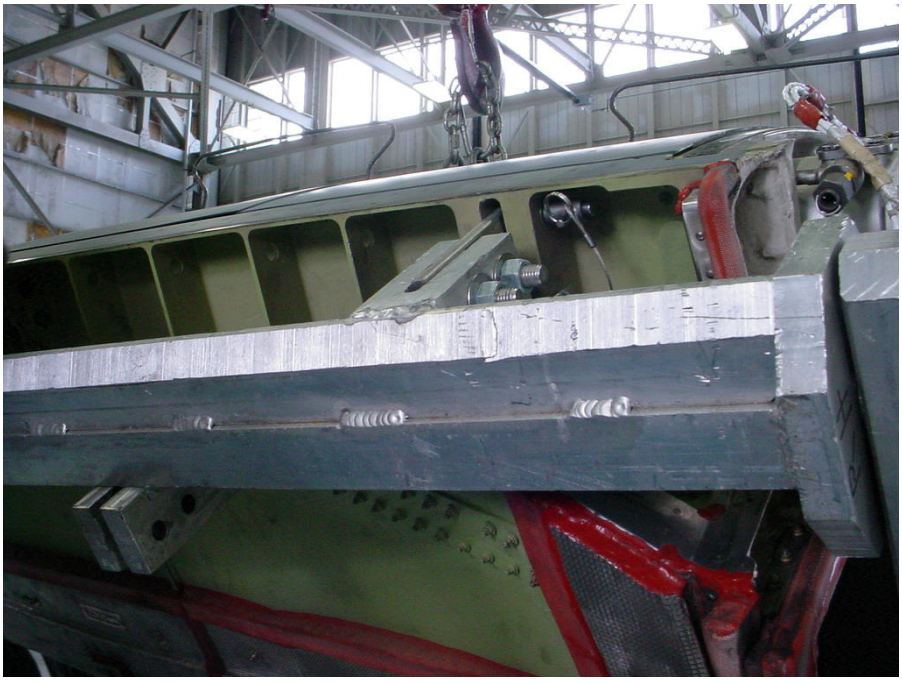


Figure 4. FTR top cradle attachment points.

Figure 5. Close up of special quick pin on top attachment points.

Figure 6. FTR bottom cradle attachment points.

Figure 7. Field sling used to place FTR onto container cradle/frame system.

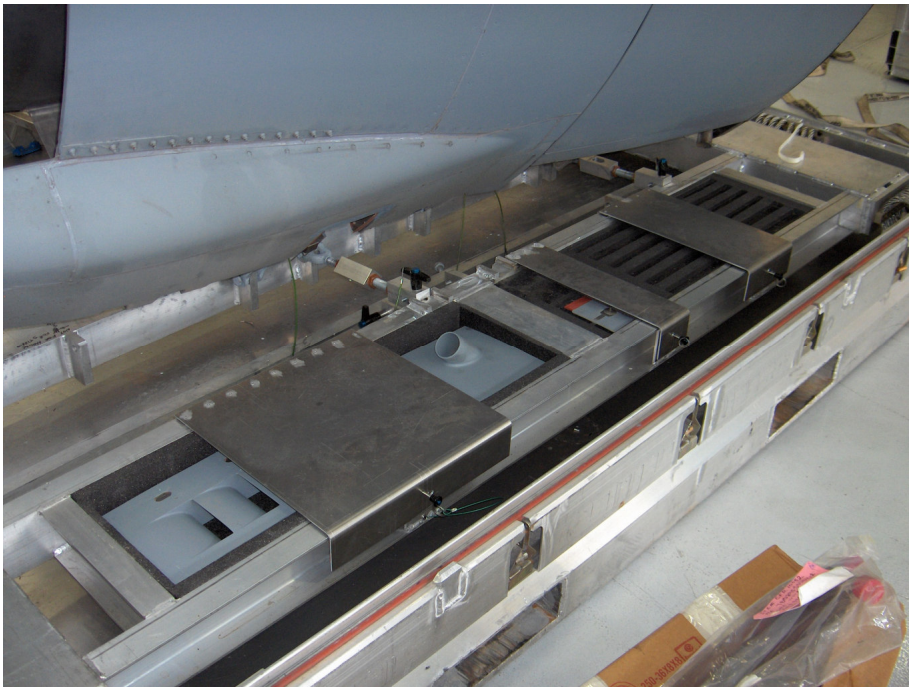


Figure 8. TFR Antenna in container base.

Figure 9. Holes on container sides are placed for viewing internal items so the cover does not have to be removed. Sealed, removable port covers will be placed in holes.

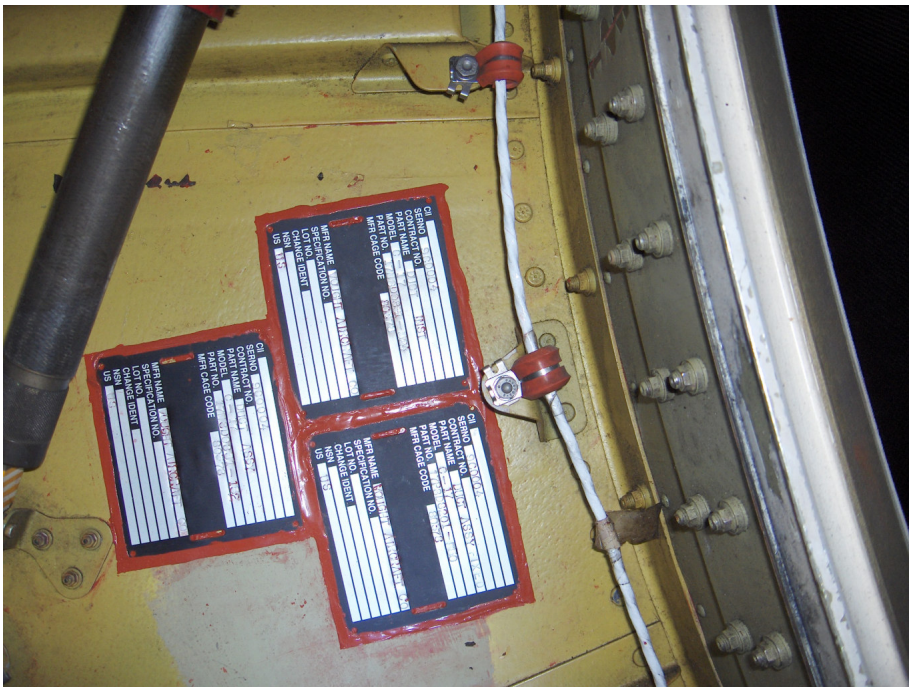


Figure 10. Identification plates, and other items such as the parts box are viewed through these special ports.

Figure 11. Placement of triaxial accelerometer.

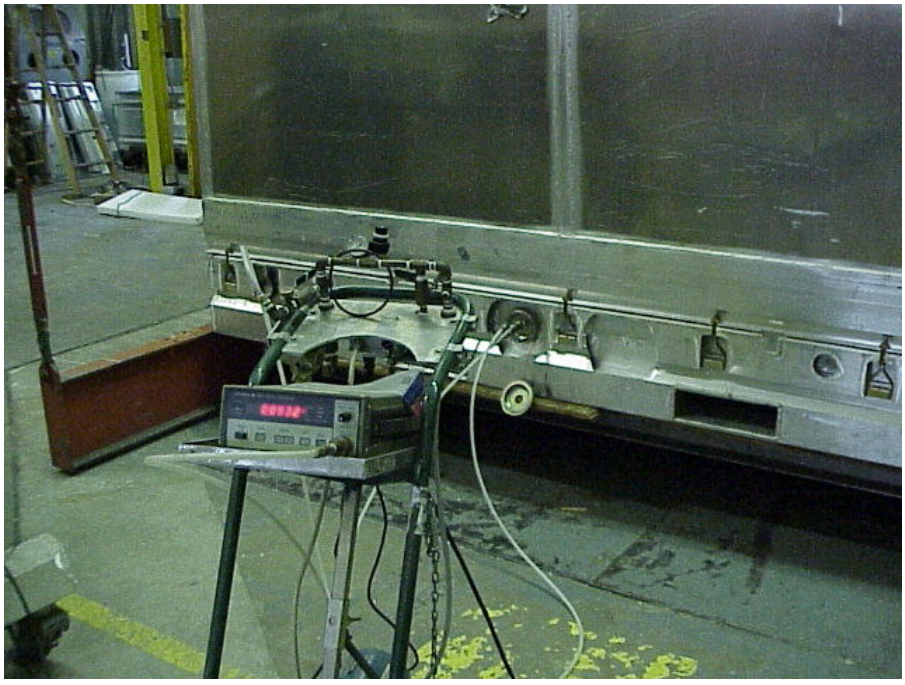


Figure 12. Pressure Test.

Figure 13. Edgewise Rotational Drop.

Figure 14. Cornerwise Rotational Drop.

Figure 15. Pendulum Impact Test.

Figure 16. Wall Deflection during Leakage Design test.

APPENDIX 3: Test Data

Table 1. Left FTR Impact Test Summary

IMPACT TYPE	TEST TEMPERATURE	IMPACT LOCATION	RESULTANT PEAK G
ROTATIONAL - CORNER	ambient	forward-left	22
ROTATIONAL - CORNER	ambient	forward-right	17
ROTATIONAL - EDGE	ambient	forward-bottom	9
ROTATIONAL - CORNER	ambient	aft-left	17
ROTATIONAL - CORNER	ambient	aft-right	30
ROTATIONAL - EDGE	ambient	aft-bottom	**
ROTATIONAL - EDGE	ambient	left-bottom	14
ROTATIONAL - EDGE	ambient	right-bottom	17
LATERAL IMPACT - FACE	ambient	forward	22
LATERAL IMPACT - FACE	ambient	aft	13
LATERAL IMPACT - FACE	ambient	left	17
LATERAL IMPACT - FACE	ambient	right	10

** The waveform for this drop was not recorded, however the resultant peak G level is known to be less than 50 Gs.

Table 2. Right FTR Impact Test Summary

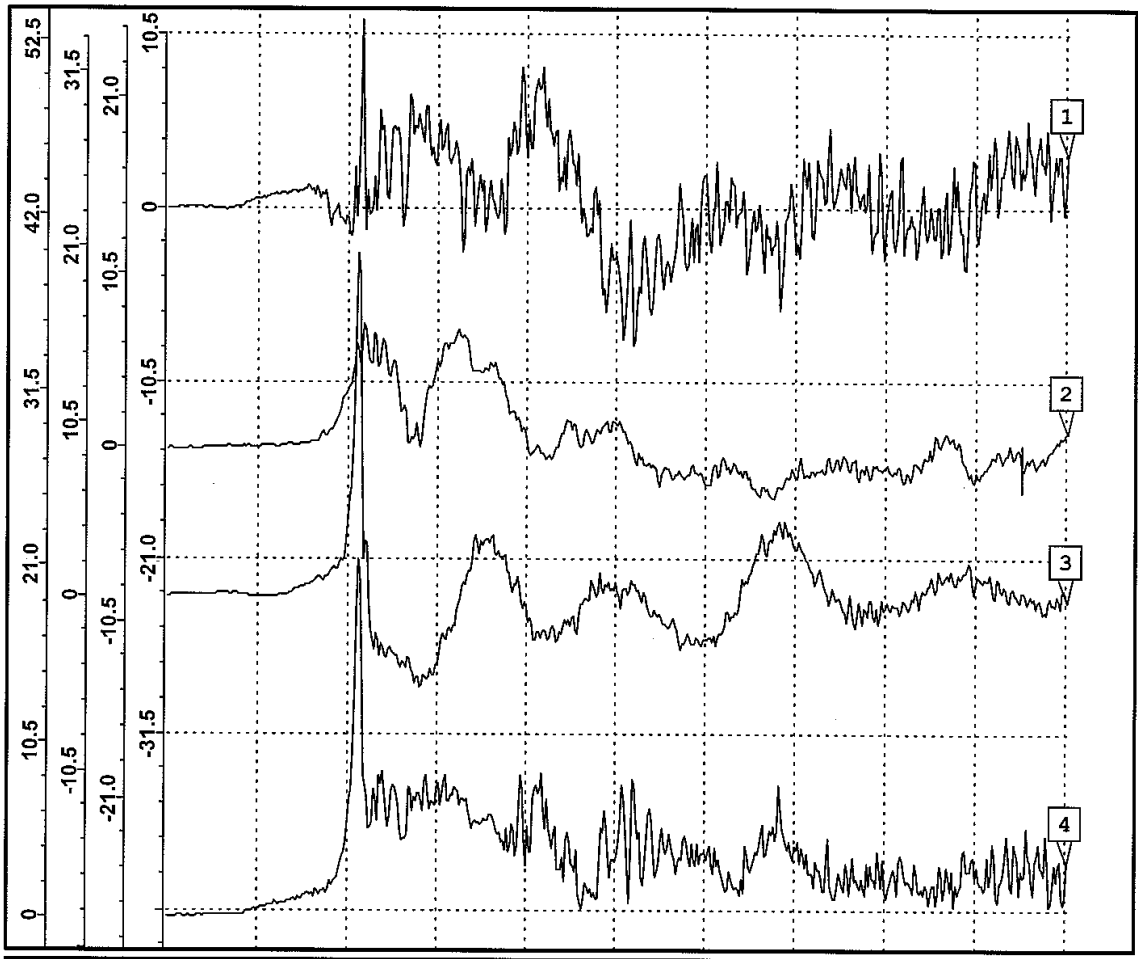
IMPACT TYPE	TEST TEMPERATURE	IMPACT LOCATION	RESULTANT PEAK G
ROTATIONAL - CORNER	ambient	forward-left	12
ROTATIONAL - CORNER	ambient	forward-right	12
ROTATIONAL - EDGE	ambient	forward-bottom	9
ROTATIONAL - CORNER	ambient	aft-left	16
ROTATIONAL - CORNER	ambient	aft-right	14
ROTATIONAL - EDGE	ambient	aft-bottom	15
ROTATIONAL - EDGE	ambient	left-bottom	14
ROTATIONAL - EDGE	ambient	right-bottom	15
LATERAL IMPACT - FACE	ambient	forward	13
LATERAL IMPACT - FACE	ambient	aft	12
LATERAL IMPACT - FACE	ambient	left	18
LATERAL IMPACT - FACE	ambient	right	14

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 9:52	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Left Forward Corner
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 26.92;H.Angle: 172.40; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	248. mS	2.43 g's	11.23 g's	44.98 In/s	26 mS	1	2
◉	2	248. mS	-1.22 g's	7.60 g's	46.08 In/s	26 mS	1	2
○	3	248. mS	0.16 g's	20.66 g's	2.73 In/s	26 mS	1	2
○	R	248. mS	2.73 g's	21.70 g's	64.45 In/s	26 mS	1	2

PEAK G RESULTANT: 22 Gs. PEAK G(Z): 21 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

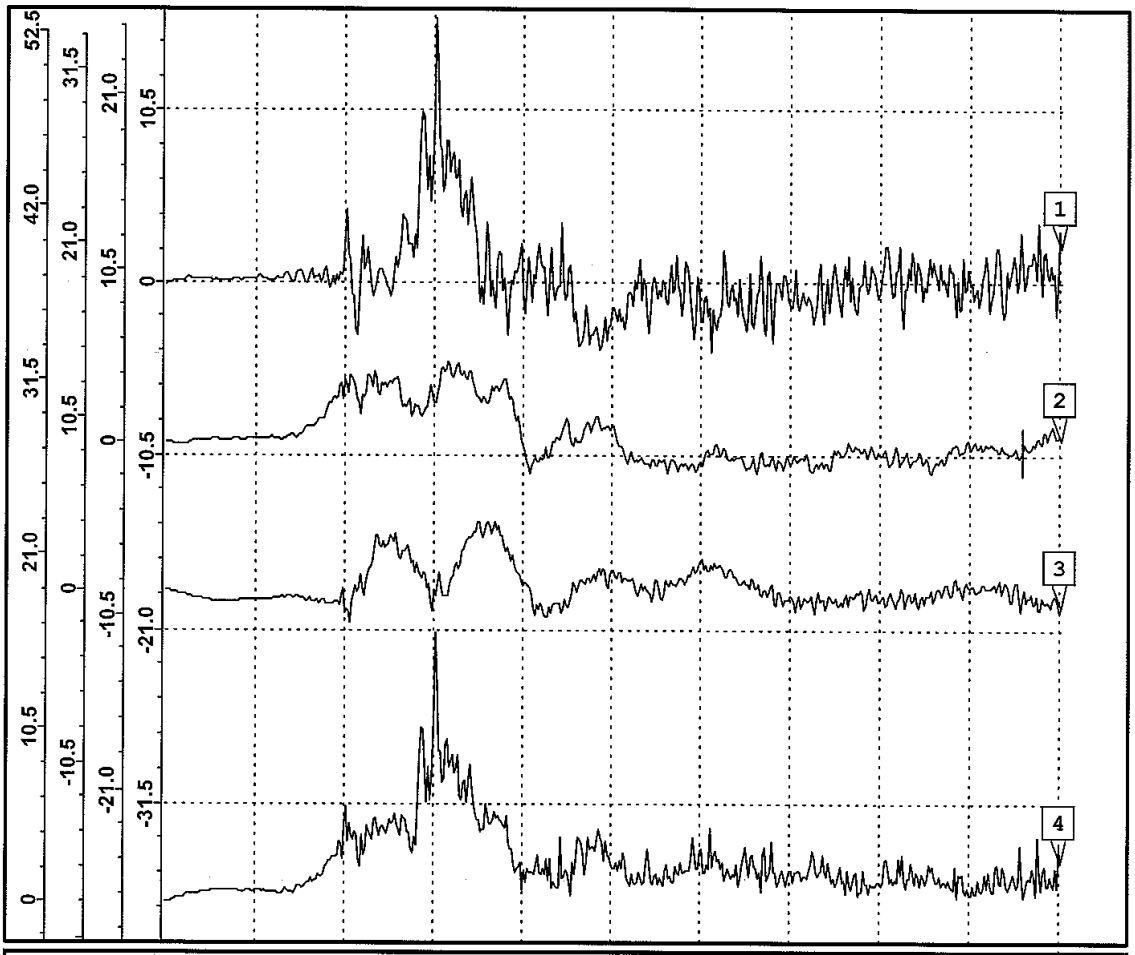
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 9:43	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Right Forward Crner
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 29.36;H.Angle: 218.73; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	250. mS	1.28 g's	16.48 g's	32.71 In/s	26 mS	1	2
◉	2	250. mS	-0.56 g's	4.90 g's	33.98 In/s	26 mS	1	2
○	3	250. mS	-0.45 g's	4.38 g's	24.04 In/s	26 mS	1	2
○	R	250. mS	1.46 g's	16.67 g's	52.95 In/s	26 mS	1	2

PEAK G RESULTANT: 17 Gs. PEAK G(X): 16 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

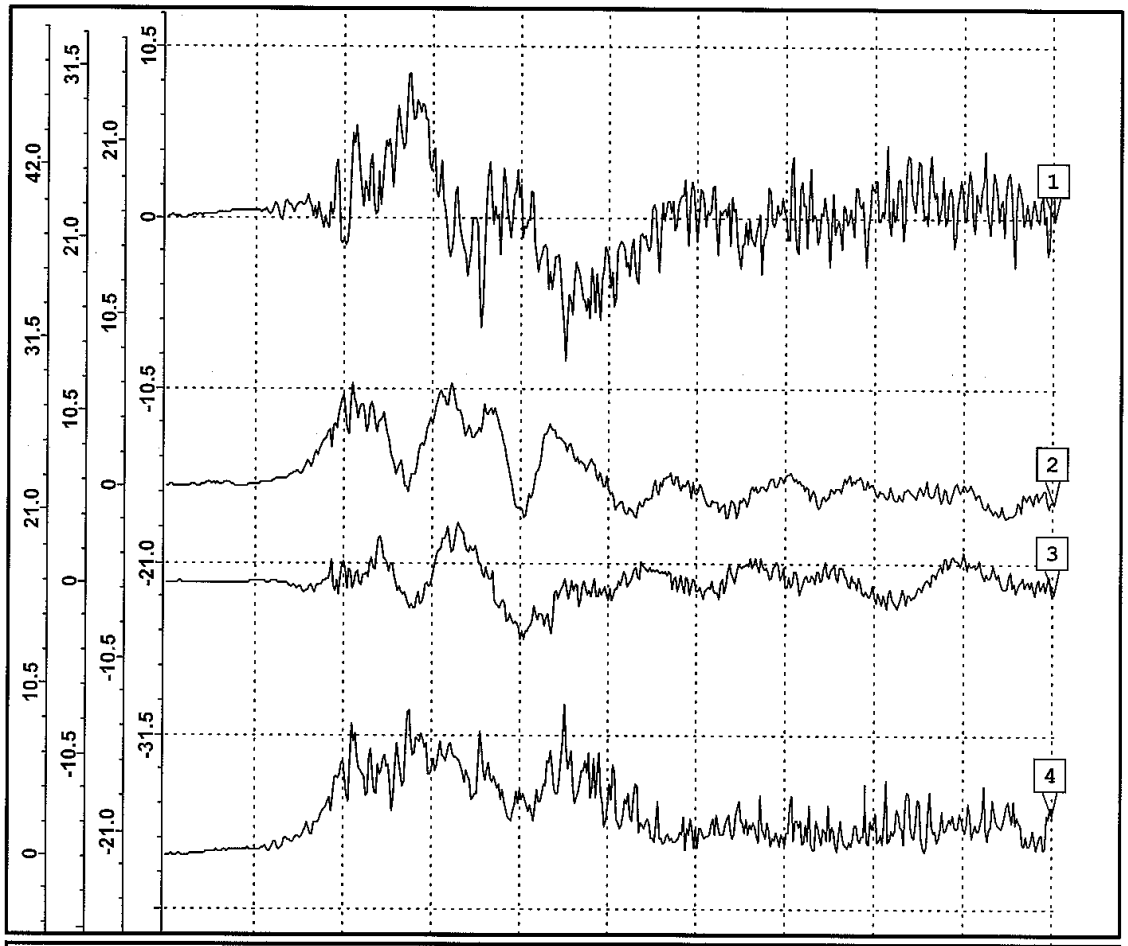
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

		Dec 14 2005 10:33	Test Engineer	:	Evans
Test type	:	Edge Drop	Impact Point	:	Forward Edge
Container/Item:		Aluminum/FTR 1	Drop Height	:	12 inches

V. Angle: 171.05;H.Angle: 254.65; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	206. mS	-2.94 g's	8.97 g's	-0.07 In/s	26 mS	1	2
○	2	206. mS	-0.12 g's	6.29 g's	83.57 In/s	26 mS	1	2
○	3	206. mS	-0.45 g's	3.72 g's	10.51 In/s	26 mS	1	2
◉	R	206. mS	2.97 g's	9.31 g's	84.23 In/s	26 mS	1	2

PEAK G RESULTANT: 9 Gs. PEAK G(X): 9 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

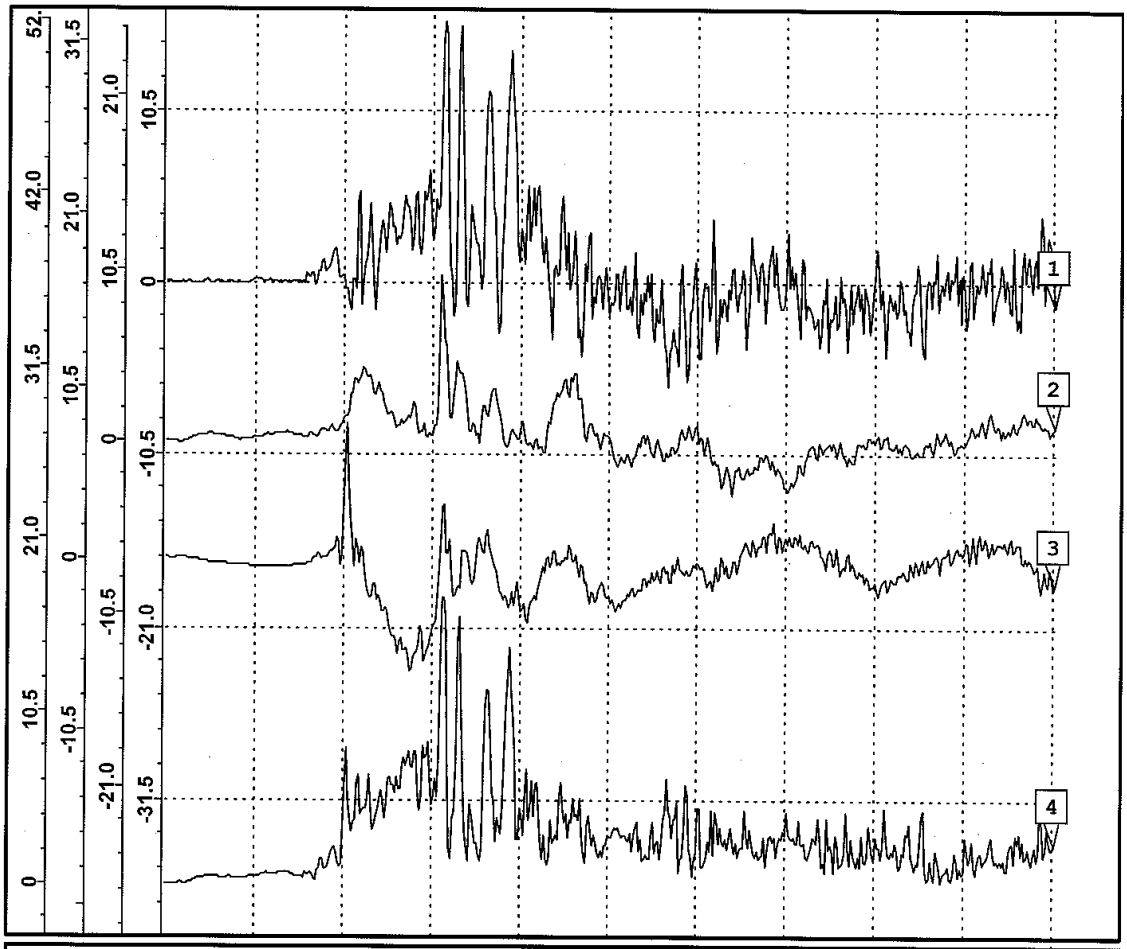
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 10:11	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Left Aft corner
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 155.76;H.Angle: 103.23; Filter: = 300 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	233. mS	-0.94 g's	15.88 g's	54.59 In/s	26 mS	1	2
2	233. mS	-0.10 g's	10.23 g's	34.80 In/s	26 mS	1	2
3	233. mS	0.41 g's	8.47 g's	-71.49 In/s	26 mS	1	2
R	233. mS	1.03 g's	17.49 g's	96.45 In/s	26 mS	1	2

PEAK G RESULTANT: 17 Gs. PEAK G(X): 16 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

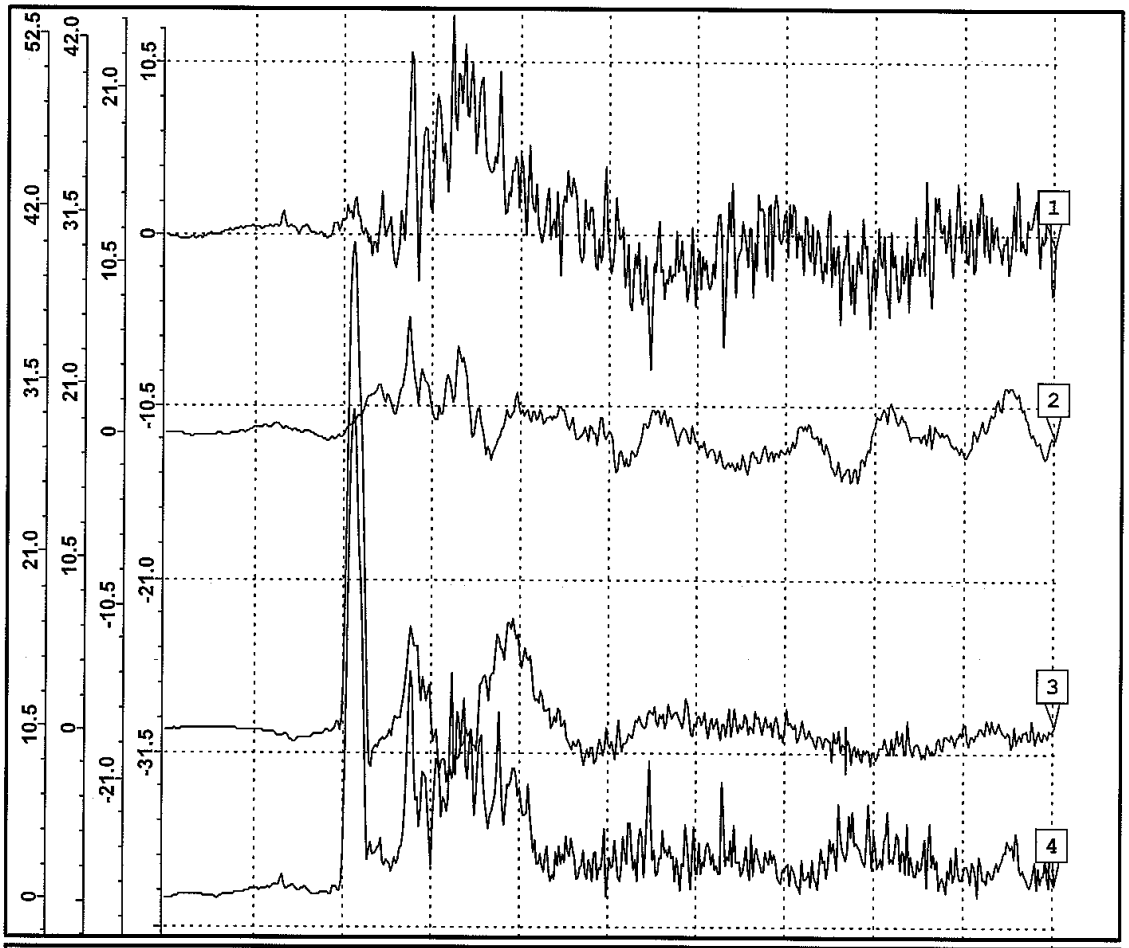
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 9:31	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Right aft corner
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 82.03;H.Angle: 210.18; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	200. mS	0.34 g's	13.47 g's	61.17 In/s	26 mS	1	2
○	2	200. mS	-2.07 g's	7.25 g's	23.90 In/s	26 mS	1	2
◉	3	200. mS	-1.21 g's	29.68 g's	82.97 In/s	26 mS	1	2
○	R	200. mS	2.42 g's	29.79 g's	105.81 In/s	26 mS	1	2

PEAK G RESULTANT: 30 Gs. PEAK G(Z): 13 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

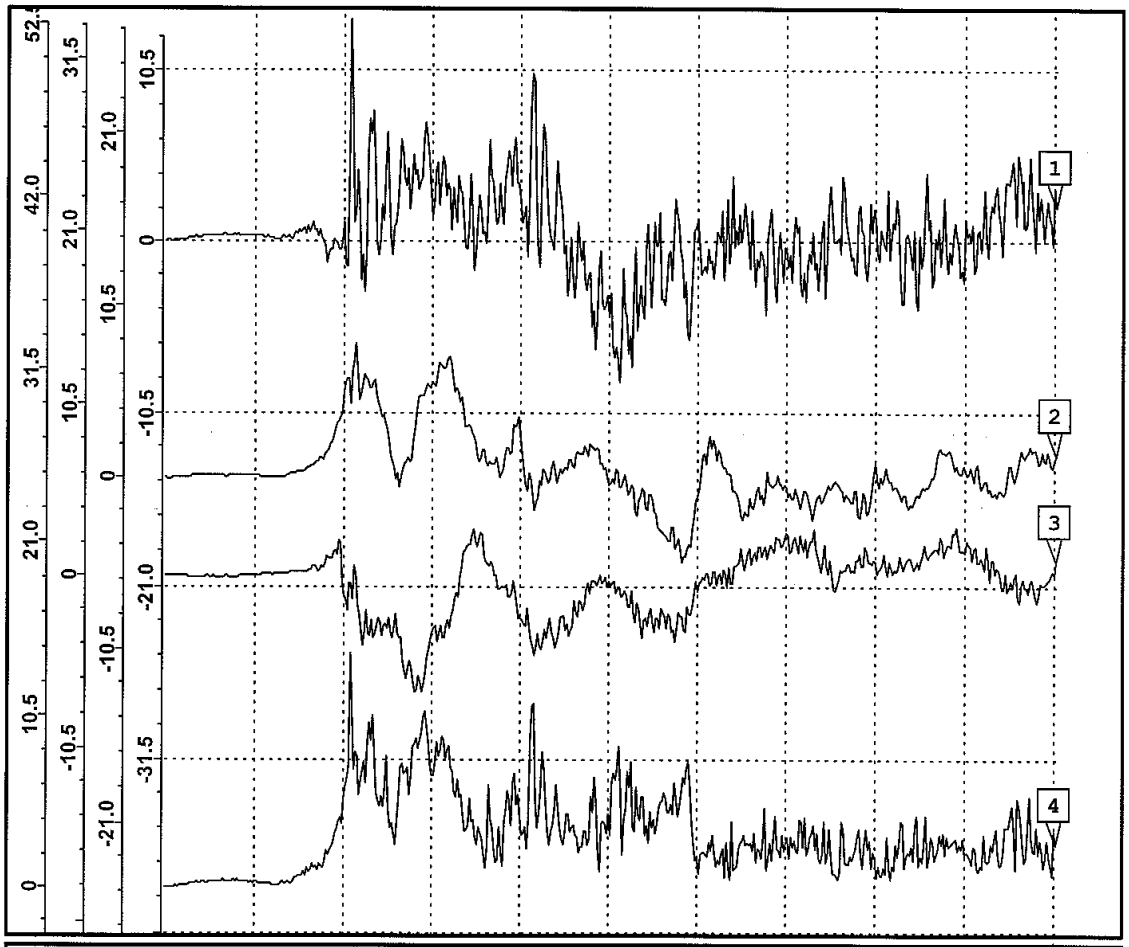
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 10:03	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Left bottom edge
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 30.55;H.Angle: 348.00; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	251. mS	2.31 g's	13.61 g's	41.19 In/s	26 mS	1	2
○	2	251. mS	1.33 g's	8.11 g's	51.17 In/s	26 mS	1	2
○	3	251. mS	-0.28 g's	-7.15 g's	-54.24 In/s	26 mS	1	2
○	R	251. mS	2.68 g's	14.34 g's	85.19 In/s	26 mS	1	2

PEAK G RESULTANT: 14 Gs. PEAK G(X): 14 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. 16473.

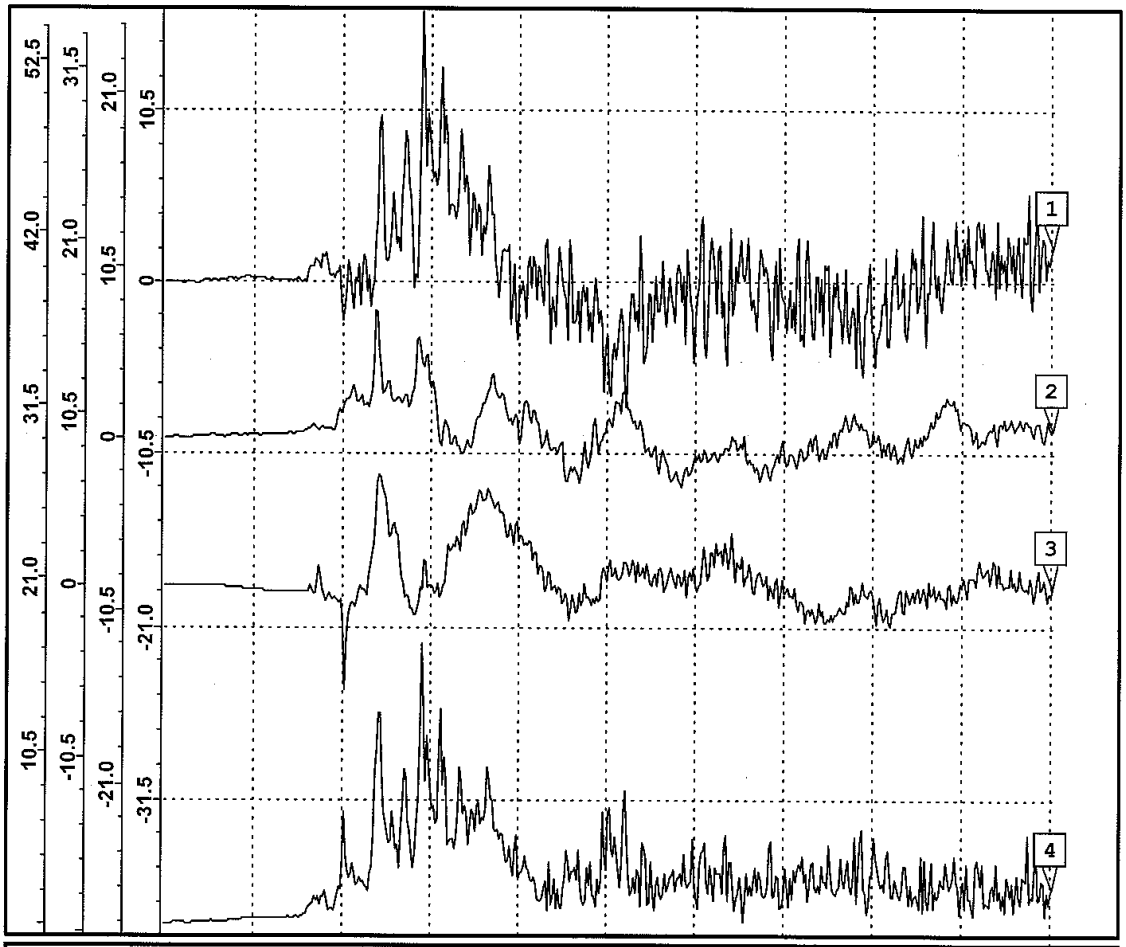
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Dec 14 2005 9:37	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Right Bottom Edge
Container/Item:	Aluminum/FTR 1	Drop Height :	12 inches

V. Angle: 88.40;H.Angle: 244.26; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	212. mS	0.06 g's	16.71 g's	27.18 In/s	26 mS	1	2
○	2	212. mS	-0.87 g's	8.06 g's	32.26 In/s	26 mS	1	2
○	3	212. mS	-1.80 g's	6.88 g's	42.41 In/s	26 mS	1	2
○	R	212. mS	2.00 g's	17.31 g's	59.81 In/s	26 mS	1	2

PEAK G RESULTANT: 17 Gs. PEAK G(X): 17 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

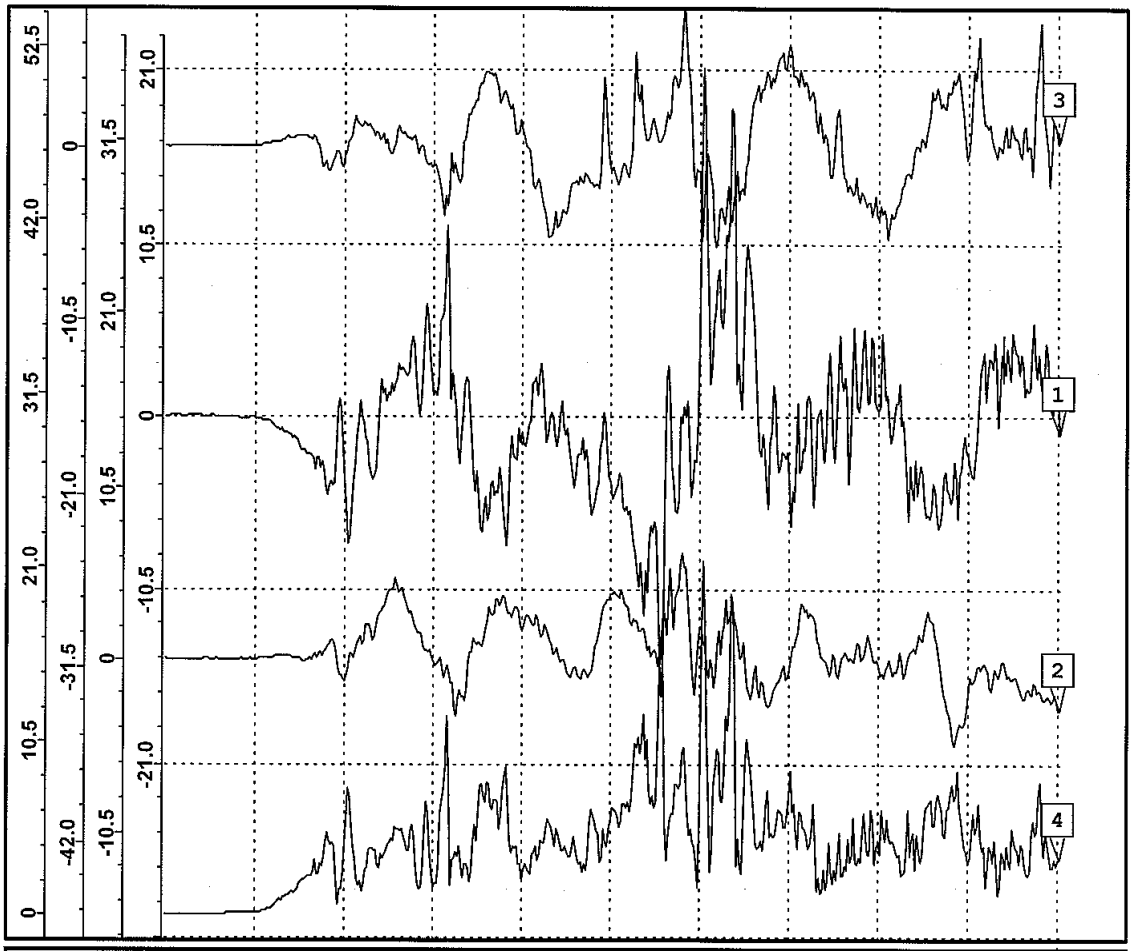
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

	Dec 13 2005 14:24	Test Engineer :	Evans
Test type :	Side impact	Impact Point :	Forward side
Container/Item:	Aluminum/FTR 1	Impact Velocty:	2.2 m/s

V. Angle: 12.12;H.Angle: 105.60; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	245. mS	3.46 g's	21.44 g's	-68.95 In/s	26 mS	1	2
○	2	245. mS	-0.20 g's	6.41 g's	56.33 In/s	26 mS	1	2
○	3	245. mS	0.72 g's	8.41 g's	18.98 In/s	26 mS	1	2
○	R	245. mS	3.54 g's	21.72 g's	91.04 In/s	26 mS	1	2

PEAK G RESULTANT: 22 Gs. PEAK G(X): 21 Gs. 300 Hz filter.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

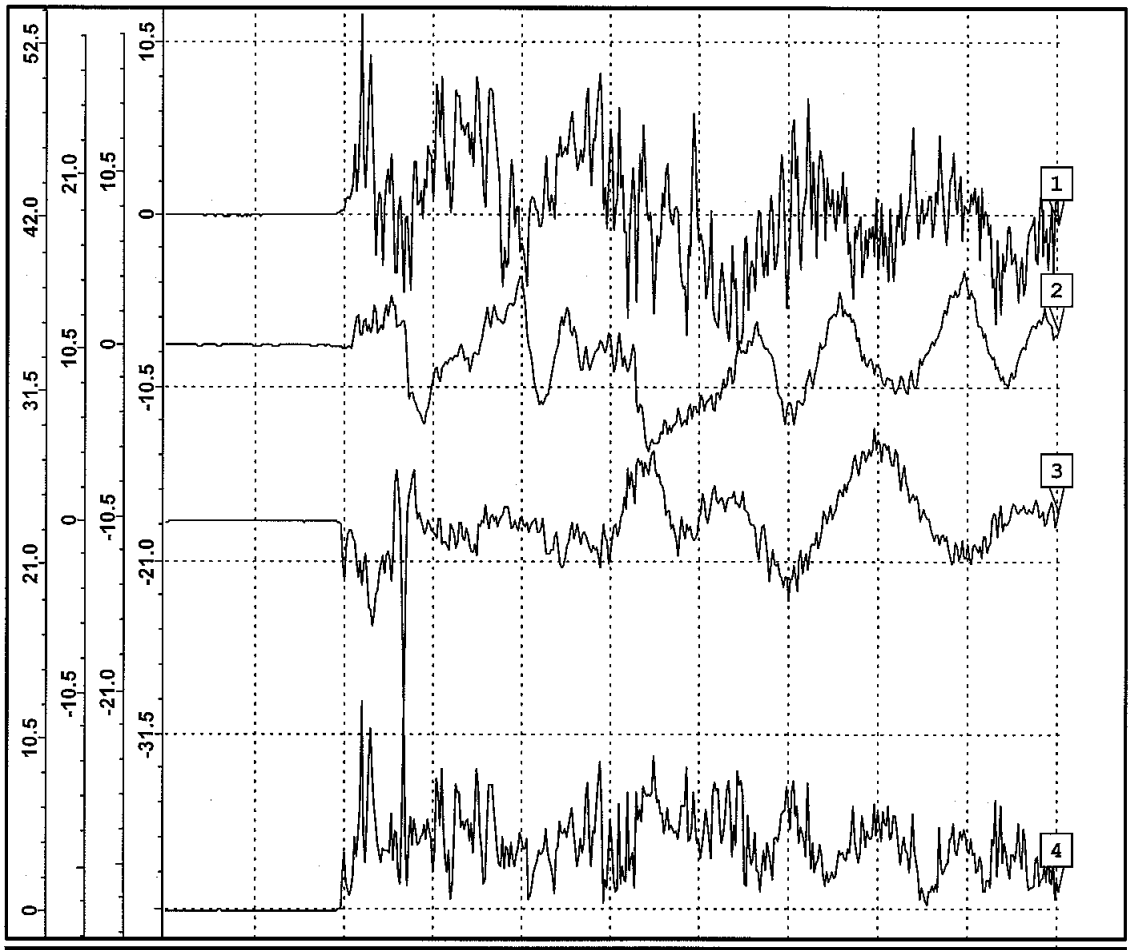
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

	Dec 14 2005 9:06	Test Engineer :	Evans
Test type :	Side impact	Impact Point :	Aft side
Container/Item:	Aluminum/FTR 1	Impact Velocty:	2.2 m/s

V. Angle: 119.41;H.Angle: 22.26; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	257. mS	-1.01 g's	12.12 g's	31.55 In/s	26 mS	1	2
○	2	257. mS	1.65 g's	-6.45 g's	-60.43 In/s	26 mS	1	2
○	3	257. mS	0.68 g's	-11.41 g's	-9.83 In/s	26 mS	1	2
○	R	256. mS	2.06 g's	12.70 g's	68.87 In/s	26 mS	1	2

PEAK G RESULTANT: 13 Gs. PEAK G(X): 12 Gs. 300 Hz filter.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

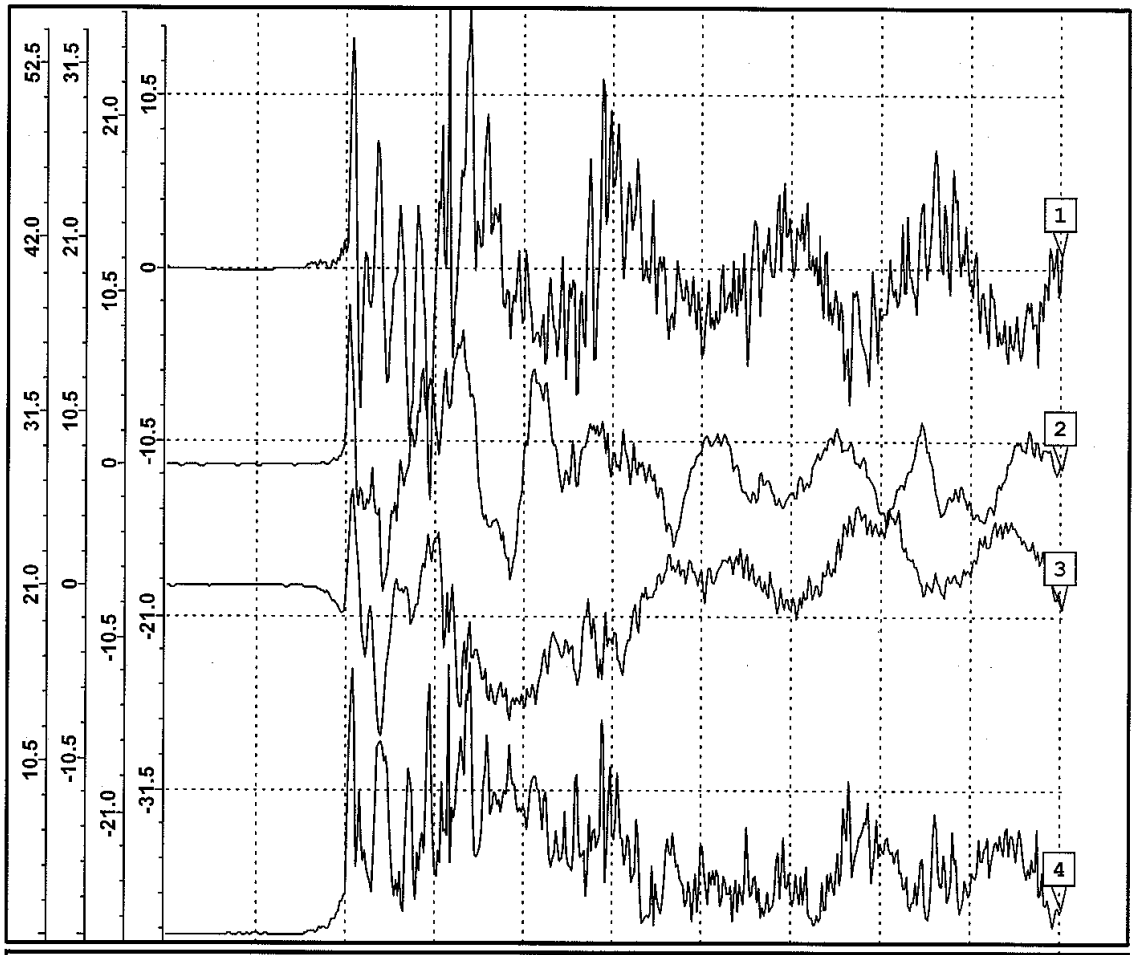
GHI SYSTEMS. INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

	Dec 14 2005 8:46	Test Engineer :	Evans
Test type :	Side impact	Impact Point :	Left side
Container/Item:	Aluminum/FTR 1	Impact Velocty:	2.2 m/s

V. Angle: 45.84;H.Angle: 309.58; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	190. mS	0.64 g's	16.14 g's	8.57 In/s	26 mS	1	2
○	2	190. mS	0.42 g's	9.76 g's	2.96 In/s	26 mS	1	2
○	3	190. mS	-0.51 g's	-9.14 g's	-106.94 In/s	26 mS	1	2
○	R	190. mS	0.92 g's	16.73 g's	107.32 In/s	26 mS	1	2

PEAK G RESULTANT: 17 Gs. PEAK G(X): 16 Gs. 300 Hz filter.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. 16473.

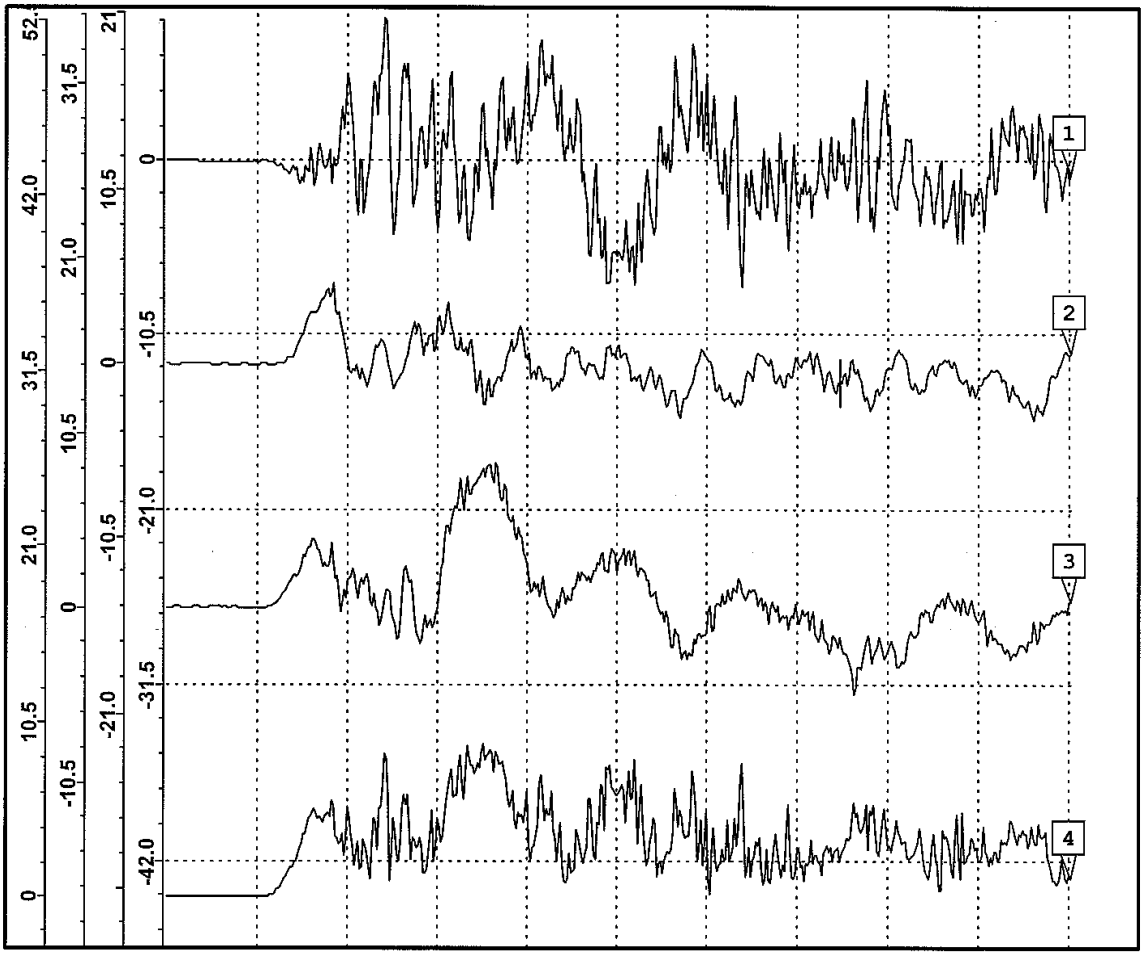
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

	Dec 13 2005 14:08	Test Engineer :	Evans
Test type :	Side impact	Impact Point :	Right side
Container/Item:	Aluminum/FTR 1	Impact Velocty:	2.2 m/s

V. Angle: 91.82;H.Angle: 236.90; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	195. mS	-0.07 g's	8.85 g's	-3.12 In/s	26 mS	1	2
◉	2	195. mS	-1.18 g's	4.94 g's	3.24 In/s	26 mS	1	2
○	3	195. mS	-1.81 g's	8.94 g's	89.55 In/s	26 mS	1	2
○	R	193. mS	2.16 g's	9.52 g's	89.66 In/s	26 mS	1	2

PEAK G RESULTANT: 10 Gs. PEAK G(X/Z): 9 Gs. 300 Hz filter.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel. S/N 16473.

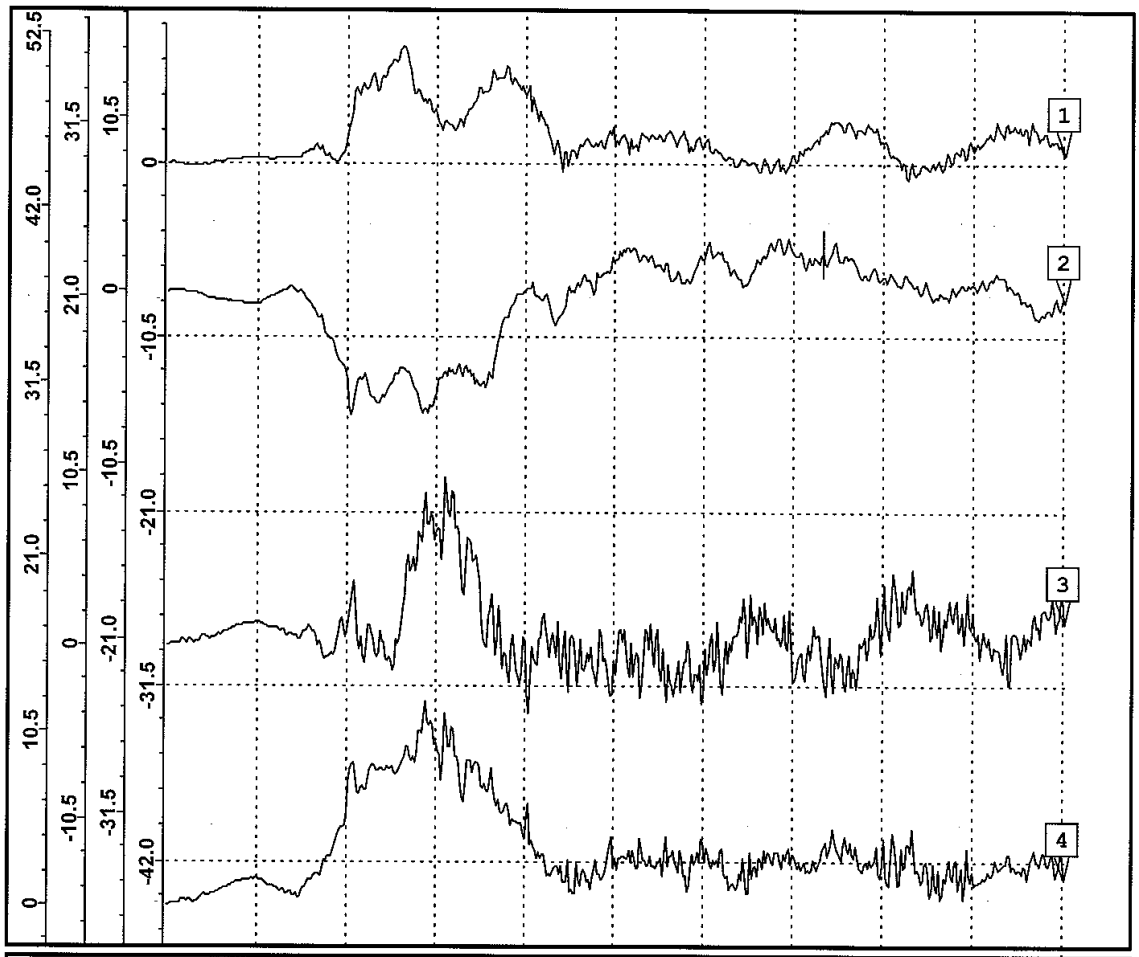
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 13:55	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Forward Left Corner
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 55.29;H.Angle: 323.29; Filter: = 300 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	191.	mS	1.88 g's	6.99 g's	128.86 In/s	26 mS	1	2
◉	2	191.	mS	2.17 g's	-7.63 g's	-77.56 In/s	26 mS	1	2
○	3	191.	mS	-1.62 g's	10.73 g's	56.68 In/s	26 mS	1	2
○	R	191.	mS	3.29 g's	12.27 g's	160.73 In/s	26 mS	1	2

PEAK G RESULTANT: 12 Gs. PEAK G(Z): 11 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

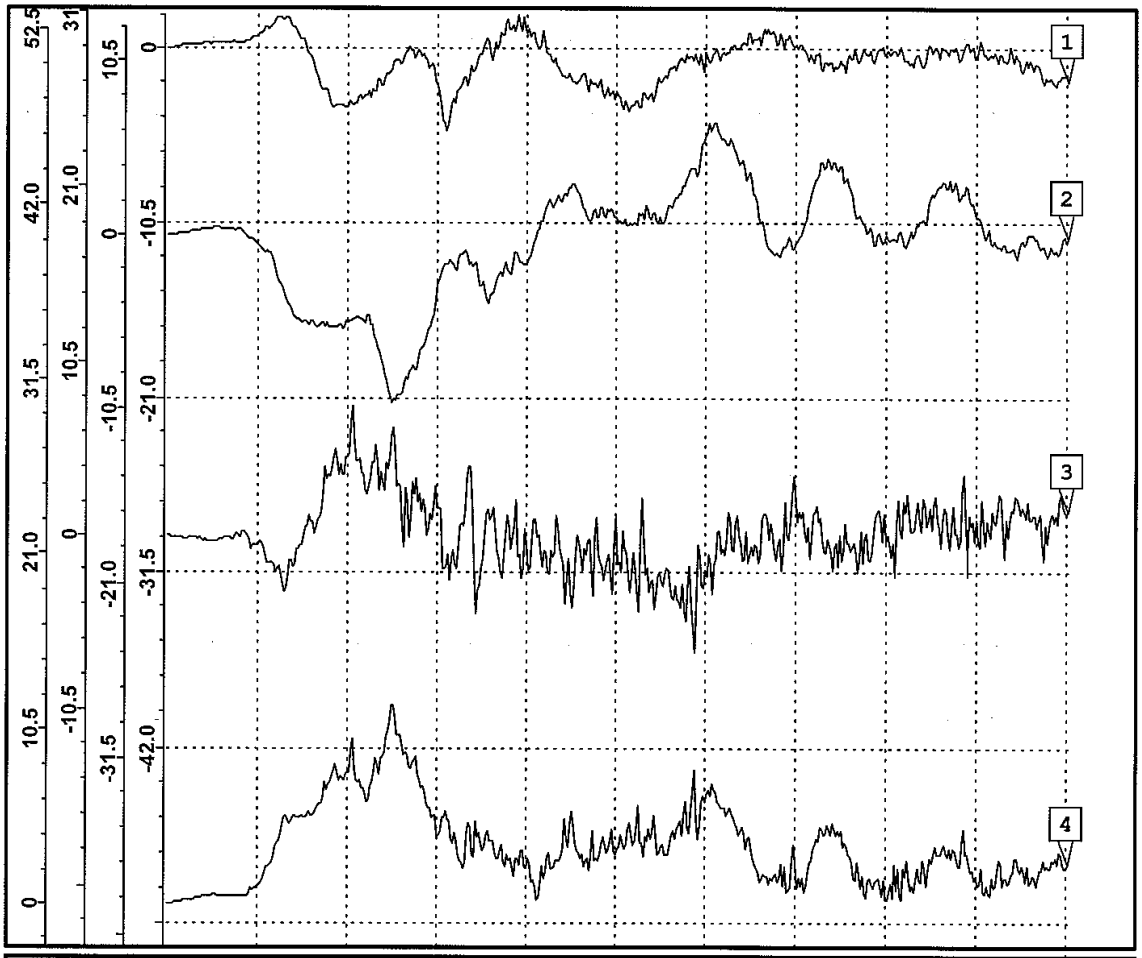
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 14:22	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Forward Right Corner
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 83.54;H.Angle: 340.49; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	232. mS	0.34 g's	-5.04 g's	-62.98 In/s	26 mS	1	2
○	2	232. mS	2.85 g's	-10.13 g's	-40.51 In/s	26 mS	1	2
◉	3	232. mS	-1.01 g's	7.94 g's	-2.06 In/s	26 mS	1	2
○	R	231. mS	3.04 g's	12.09 g's	74.91 In/s	26 mS	1	2

PEAK G RESULTANT: 12 Gs. PEAK G(Y): 10 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

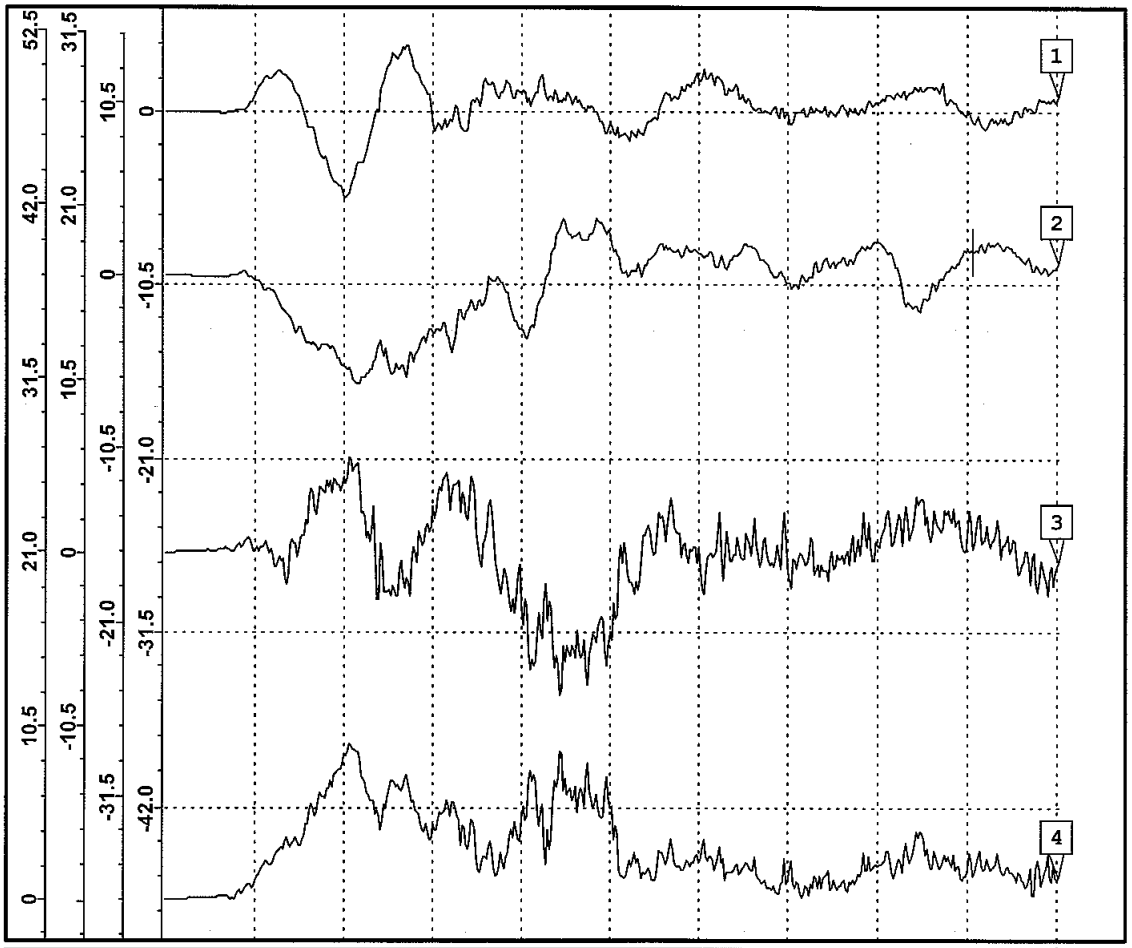
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 14:48	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Forward Bottom Edge
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 110.90;H.Angle: 7.25; Filter: = 300 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	236.	mS	-0.52 g's	-5.16 g's	33.62 In/s	26 mS	1	2
◉	2	236.	mS	1.35 g's	-6.63 g's	-72.53 In/s	26 mS	1	2
○	3	236.	mS	0.17 g's	-8.91 g's	-0.89 In/s	26 mS	1	2
○	R	236.	mS	1.45 g's	9.46 g's	79.95 In/s	26 mS	1	2

PEAK G RESULTANT: 9 Gs. PEAK G(Z): 9 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

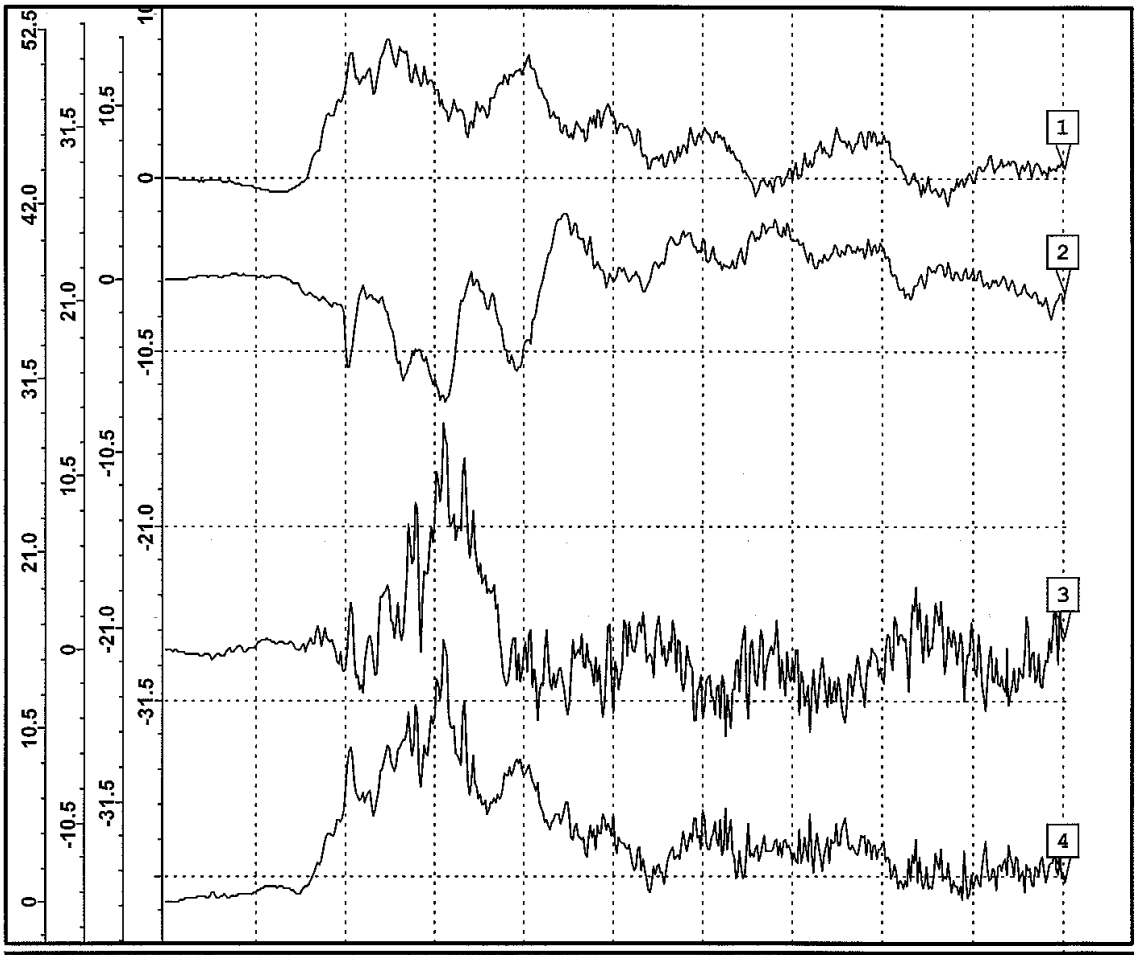
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 14:15	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Aft Left Crnr
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 58.79;H.Angle: 254.00; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	244. mS	0.86 g's	8.43 g's	210.64 In/s	26 mS	1	2
○	2	244. mS	-0.39 g's	-7.41 g's	-12.44 In/s	26 mS	1	2
◉	3	244. mS	-1.36 g's	14.07 g's	21.67 In/s	26 mS	1	2
○	R	244. mS	1.65 g's	16.27 g's	212.11 In/s	26 mS	1	2

PEAK G RESULTANT: 16 Gs. PEAK G(Z): 14 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

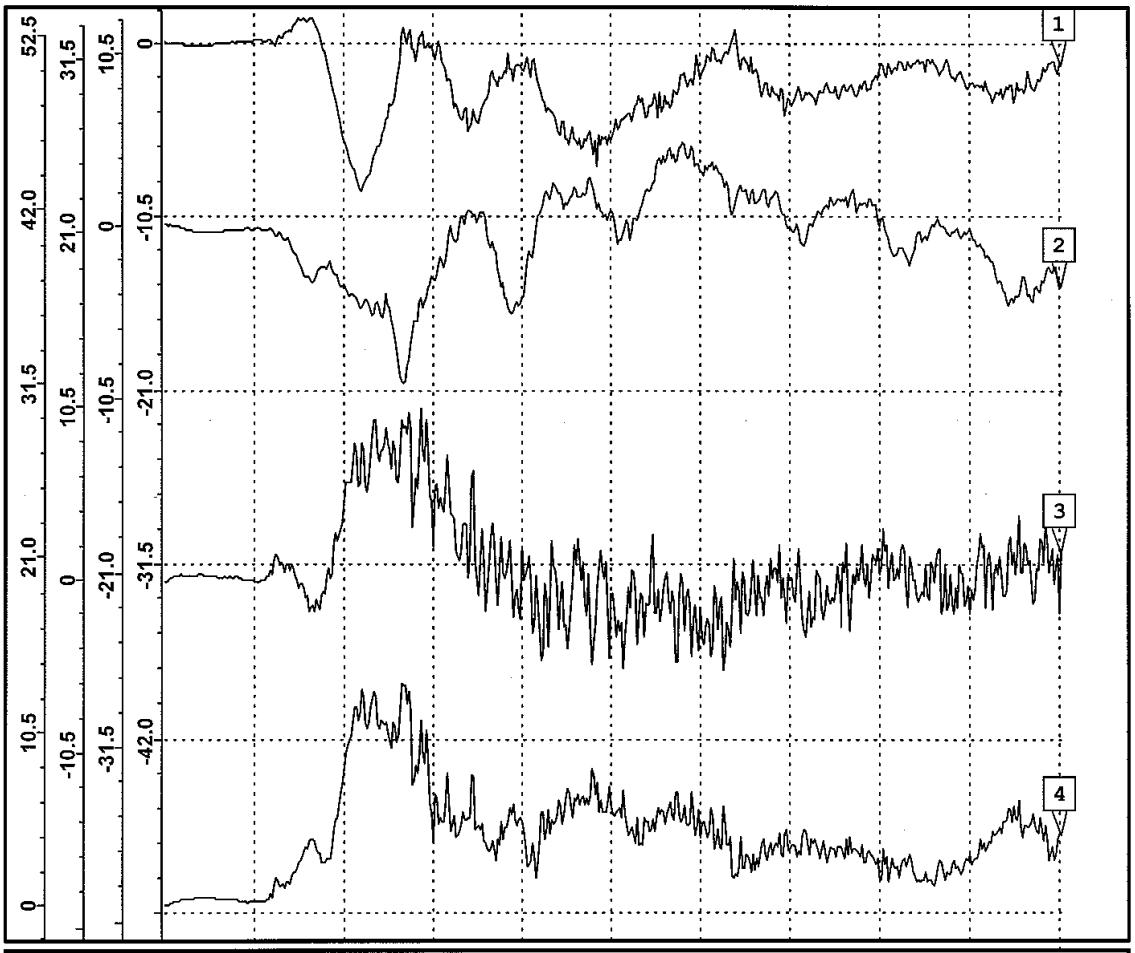
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 13:46	Test Engineer :	Evans
Test type :	Corner Drop	Impact Point :	Aft Right Corner
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 145.95;H.Angle: 316.58; Filter: = 300 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	197. mS	-2.98 g's	-8.96 g's	-182.62 In/s	26 mS	1	2
○	2	197. mS	1.46 g's	-9.60 g's	-36.36 In/s	26 mS	1	2
◉	3	197. mS	-1.39 g's	10.40 g's	56.38 In/s	26 mS	1	2
○	R	197. mS	3.60 g's	14.10 g's	194.55 In/s	26 mS	1	2

PEAK G RESULTANT: 14 Gs. PEAK G(Z): 10 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

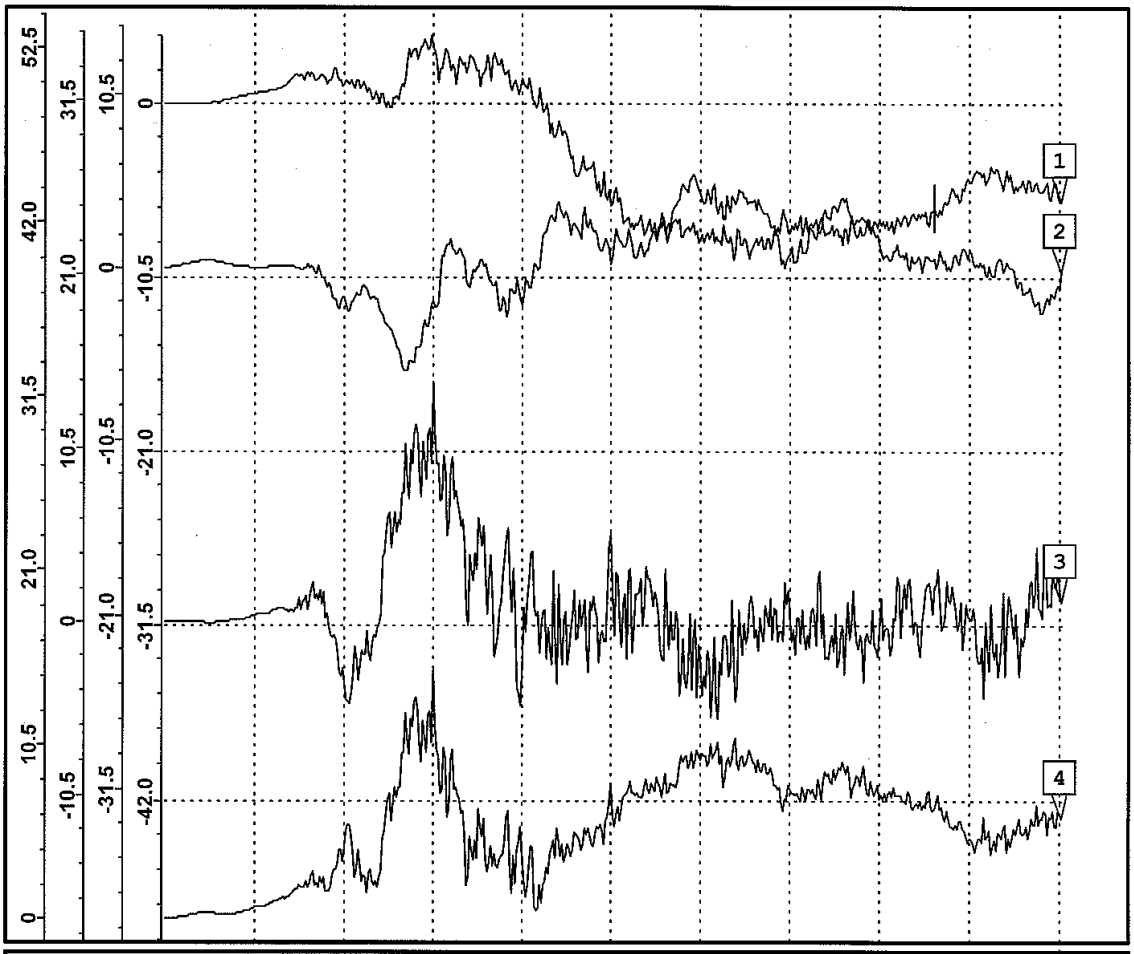
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 14:42	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Aft Bottom Edge
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 160.61;H.Angle: 77.38; Filter: = 300 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	224.	mS	-6.27 g's	-9.47 g's	-247.52 In/s	26 mS	1	2
○	2	224.	mS	0.48 g's	-6.32 g's	62.15 In/s	26 mS	1	2
○	3	224.	mS	2.15 g's	14.42 g's	66.98 In/s	26 mS	1	2
○	R	224.	mS	6.64 g's	14.94 g's	263.85 In/s	26 mS	1	2

PEAK G RESULTANT: 15 Gs. PEAK G(Z): 14 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

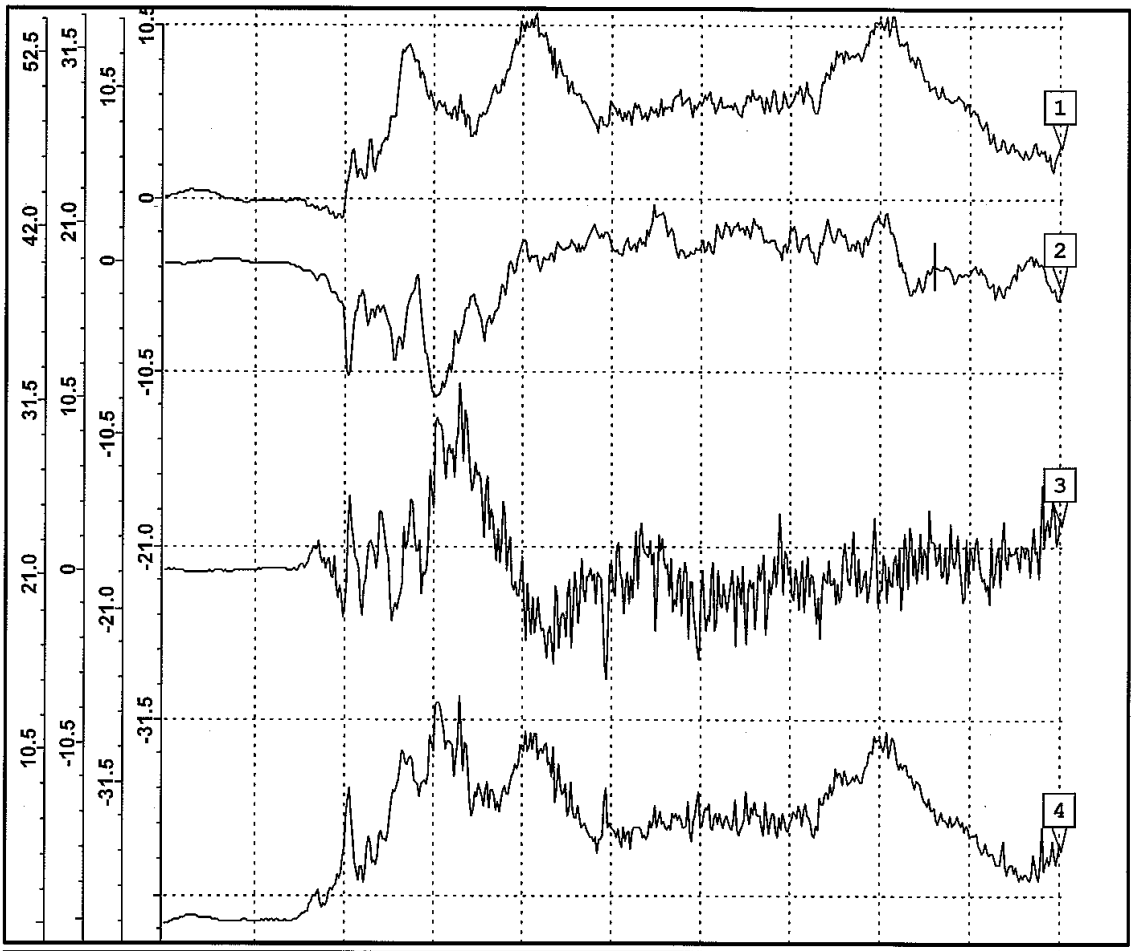
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 14:11	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Left Edge
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 13.94;H.Angle: 97.76; Filter: = 300 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	224. mS	6.79 g's	11.21 g's	425.94 In/s	26 mS	1	2
2	224. mS	-0.23 g's	-8.18 g's	-28.85 In/s	26 mS	1	2
3	224. mS	1.67 g's	11.93 g's	13.16 In/s	26 mS	1	2
R	224. mS	6.99 g's	14.00 g's	427.11 In/s	26 mS	1	2

PEAK G RESULTANT: 14 Gs. PEAK G(Z): 12 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

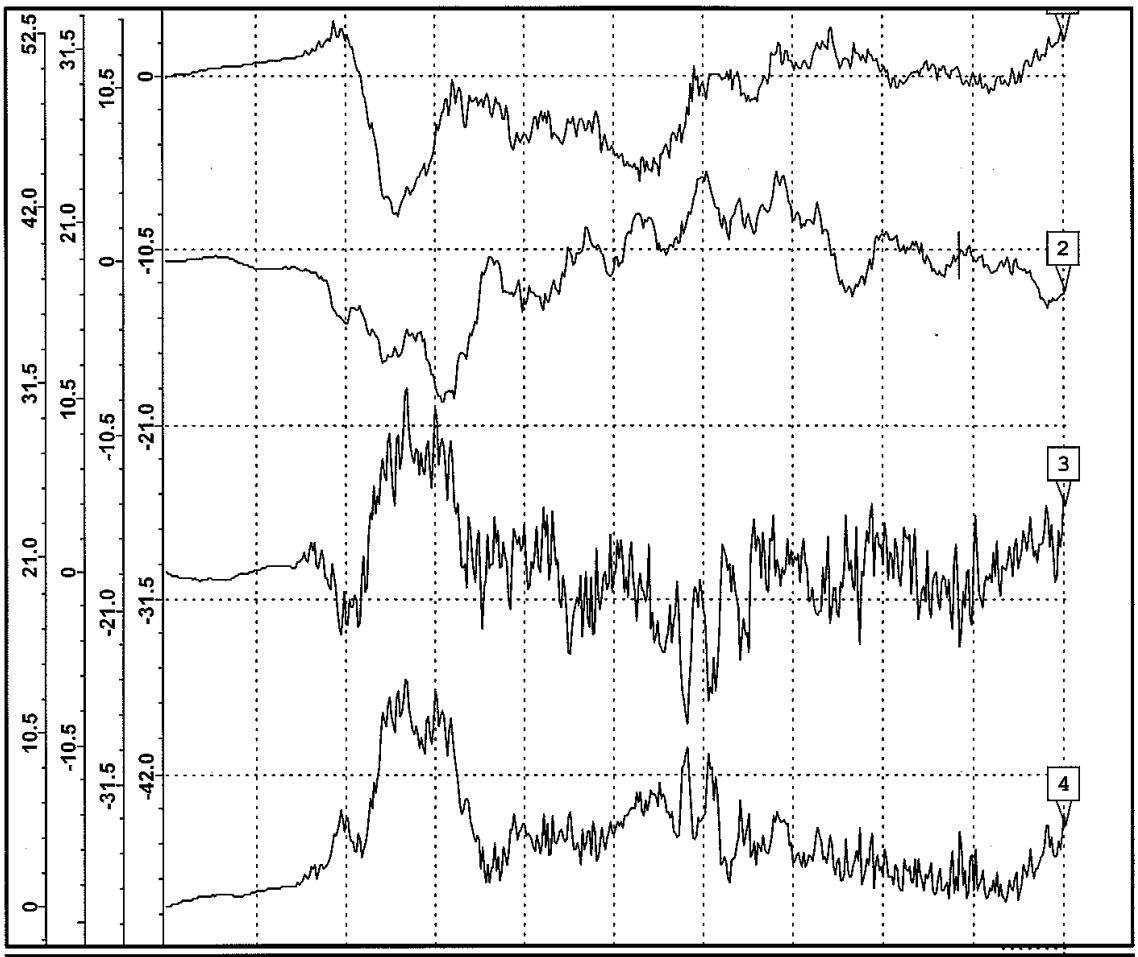
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

ROTATIONAL DROP TEST

	Jan 3 2006 13:50	Test Engineer :	Evans
Test type :	Edge Drop	Impact Point :	Right Bottom Edge
Container/Item:	Aluminum/FTR 2	Drop Height :	12 inches

V. Angle: 84.75;H.Angle: 274.84; Filter: = 300 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div		Hexp	Vexp
○	1	230.	mS	0.41 g's	-8.38 g's	-104.03 In/s	26	mS	1	2
◉	2	230.	mS	0.38 g's	-8.39 g's	-34.17 In/s	26	mS	1	2
○	3	230.	mS	-4.43 g's	11.37 g's	28.57 In/s	26	mS	1	2
○	R	230.	mS	4.47 g's	13.86 g's	113.17 In/s	26	mS	1	2

PEAK G RESULTANT: 14 Gs. PEAK G(Z): 11 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(vert.); Ch2 = Y(long.); Ch3 = Z(trans.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

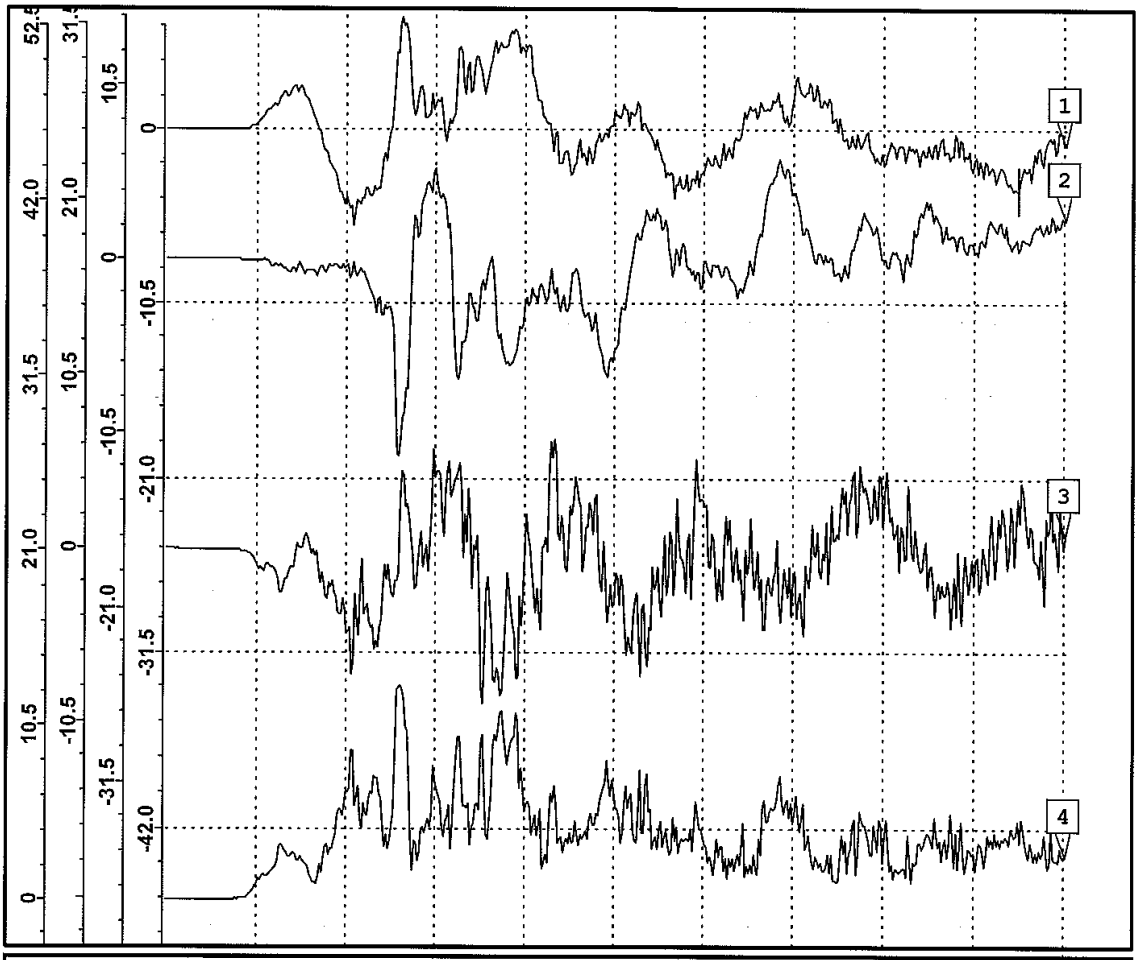
GHI SYSTEMS INC CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

Jan 4 2006 8:22 Test Engineer : Evans
Test type : Impact Impact Point : Forward Side
Container/Item: Aluminum/FTR 2 Impact Velocty: 2.2 m/sec

V. Angle: 140.35;H.Angle: 81.15; Filter: = 500 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	247. mS	-3.68 g's	6.94 g's	0.82 In/s	26 mS	1	2
2	247. mS	0.47 g's	-12.00 g's	-39.77 In/s	26 mS	1	2
3	247. mS	3.02 g's	-10.20 g's	-74.25 In/s	26 mS	1	2
R	247. mS	4.78 g's	13.01 g's	84.24 In/s	26 mS	1	2

PEAK G RESULTANT: 13 Gs. PEAK G(Y): 12 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

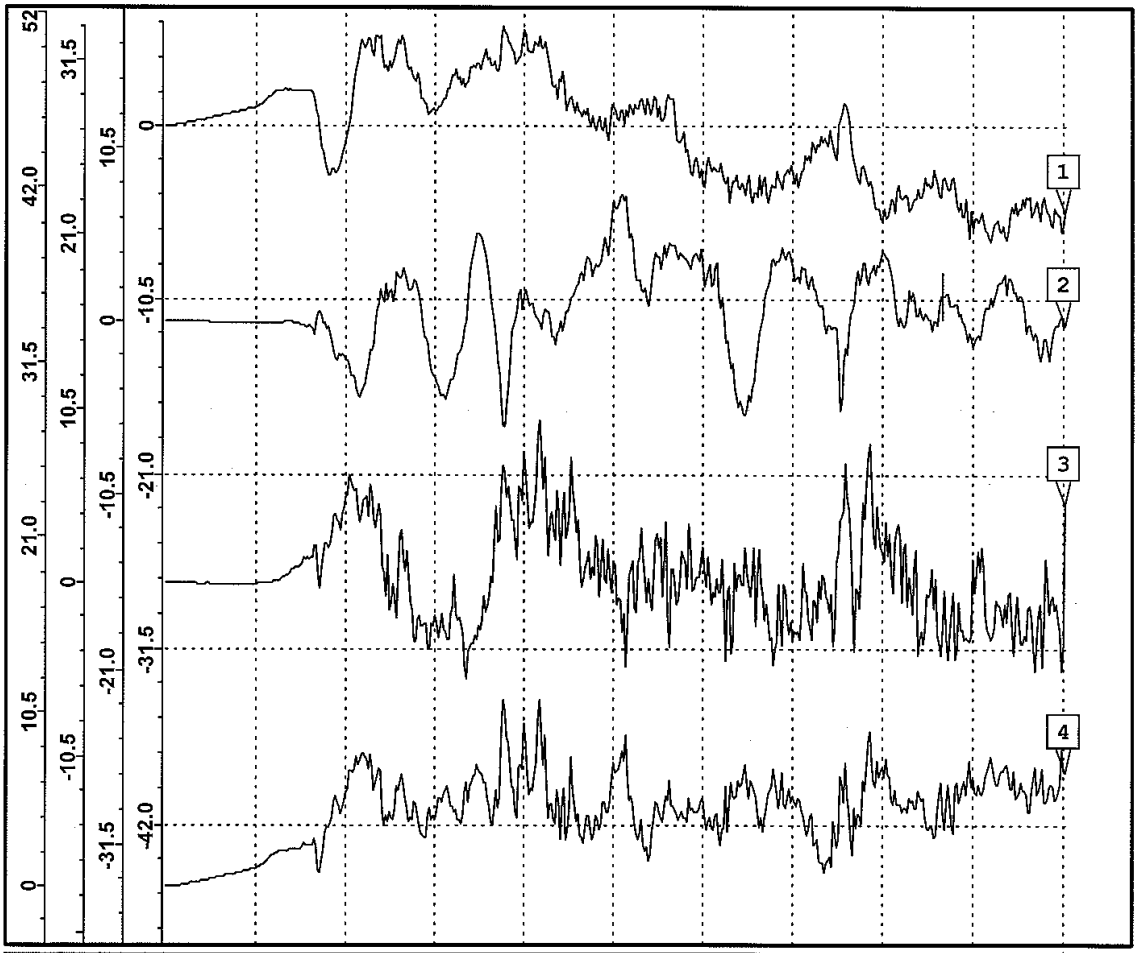
GHI SYSTEMS. INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

	Jan 4 2006 7:56	Test Engineer :	Evans
Test type :	Impact	Impact Point :	Aft Side
Container/Item:	Aluminum/FTR 2	Impact Velocty:	2.2 m/sec

V. Angle: 134.94;H.Angle: 299.08; Filter: = 500 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	226. mS	-3.13 g's	5.99 g's	21.96 In/s	26 mS	1	2
◉	2	226. mS	1.52 g's	7.57 g's	67.15 In/s	26 mS	1	2
○	3	226. mS	-2.74 g's	9.94 g's	55.35 In/s	26 mS	1	2
○	R	226. mS	4.43 g's	11.64 g's	89.75 In/s	26 mS	1	2

PEAK G RESULTANT: 12 Gs. PEAK G(Z): 10 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

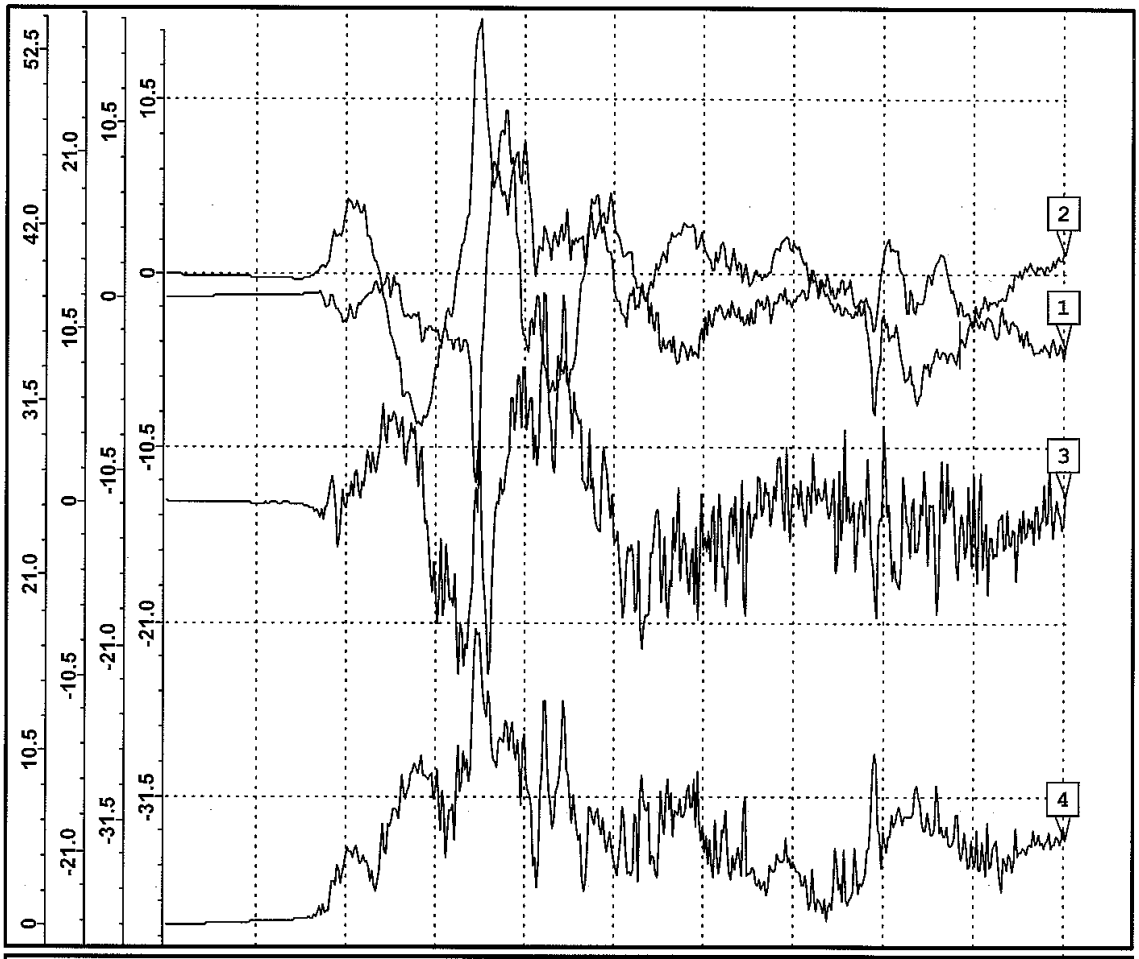
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

Jan 4 2006 12:44 — Test Engineer : Evans
Test type : Impact — Impact Point : Left Side
Container/Item: Aluminum/FTR 2 — Impact Velocty: 2.2 m/sec

V. Angle: 155.05;H.Angle: 262.38; Filter: = 500 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	230. mS	-4.19 g's	15.43 g's	-64.20 In/s	26 mS	1	2
○	2	230. mS	-0.26 g's	-11.59 g's	45.40 In/s	26 mS	1	2
○	3	230. mS	-1.93 g's	14.67 g's	-31.69 In/s	26 mS	1	2
○	R	230. mS	4.62 g's	18.32 g's	84.78 In/s	26 mS	1	2

PEAK G RESULTANT: 18 Gs. PEAK G(X/Z): 15 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

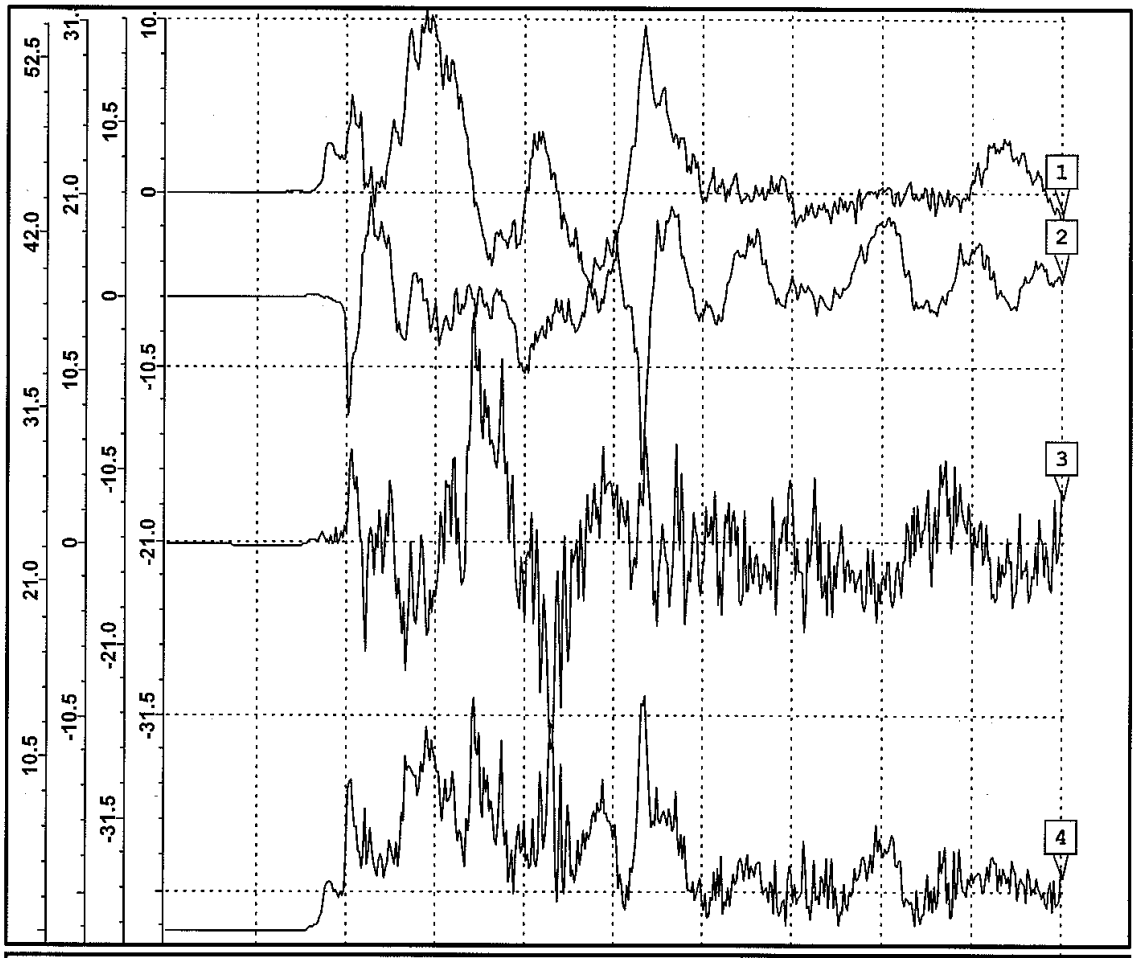
GHI SYSTEMS, INC. CAT SYSTEM

C17 FAN THRUST REVERSER

PENDULUM IMPACT TEST

Jan 4 2006 8:09 — Test Engineer : Evans
Test type : Impact — Impact Point : Right Side
Container/Item: Aluminum/FTR 2 — Impact Velocty: 2.2 m/sec

V. Angle: 107.78;H.Angle: 130.83; Filter: = 500 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	218. mS	-0.37 g's	11.14 g's	74.61 In/s	26 mS	1	2
○	2	218. mS	-0.76 g's	-10.73 g's	20.33 In/s	26 mS	1	2
◉	3	218. mS	0.88 g's	14.01 g's	-7.96 In/s	26 mS	1	2
○	R	218. mS	1.23 g's	14.43 g's	77.74 In/s	26 mS	1	2

PEAK G RESULTANT: 14 Gs. PEAK G(Z): 14 Gs.

ACCELEROMETER OUTPUT: Ch1 = X(lt-rt); Ch2 = Y(fwd-aft); Ch3 = Z(vert.)
Ch4 = Resultant. Accelerometer at 45°angle.
Aft side = desiccant port end.
Ambient temperature _humidity.
ASTM D 4169, ASTM D 6179. SAE ARP1967. Accel S/N 16473.

GHI SYSTEMS, INC. CAT SYSTEM

APPENDIX 4: Test Instrumentation

PRESSURE TEST EQUIPMENT - Test sequences 1 & 6

EQUIPMENT	MANUFACTURER	MODEL	SN	CAL. DATE
Digital Manometer	Yokogawa	2655	82DJ6009	August 05

ROUGH HANDLING TEST EQUIPMENT - Test sequences 2 - 5.

EQUIPMENT	MANUFACTURER	MODEL	SN	CAL. DATE
Shock Amplifier	Endevco	2775A	ER34	NA
Shock Amplifier	Endevco	2775A	ER33	NA
Shock Amplifier	Endevco	2775A	EL81	NA
Item Accelerometer	Endevco	2228C	16473	May 05
Data Acquisition	GHI Systems	CAT	Ver. 2.7.1	N/A

APPENDIX 5: Distribution List

DISTRIBUTION LIST

DTIC/O
DEFENSE TECHNICAL INFORMATION CENTER
FORT BELVOIR VA 22060-6218

AFMC LSO/LO
WRIGHT-PATTERSON AFB OH 45433-5540

448 MSUG/GBMST
TINKER AFB OK 73145

84 MSUG/GBMSCA
HILL AFB UT 84056-5805

542 MSUG/GBMSCA
ROBINS AFB GA 31098-1670

564 ACSS/GFLC (ATTN: Erna Gomez)
44 GREEN STREET, #100
WARNER ROBINS, GA 31093

516 AESG/LGP (ATTN: Stan Smigiel)
2590 LOOP ROAD WEST
WRIGHT-PATTERSON AFB OH 45433-7142

THE BOEING COMPANY
ATTN: GUY BREDESEN M/C C078-0432
2401 E WARDLOW RD
LONG BEACH, CA 90801-5608

APPENDIX 6: Report Documentation

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
05-11-2006	Technical, Final Project Report	May 04 - Feb 06

4. TITLE AND SUBTITLE

Development of the C-17 Fan Thrust Reverser (FTR) Container

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

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5d. PROJECT NUMBER
05-P-102

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Air Force Packaging Technology and Engineering Facility
AFMC LSO/LOP
5215 THURLOW ST, STE 5, BLDG 70C
WRIGHT-PATTERSON AFB OH 45433-5540

8. PERFORMING ORGANIZATION REPORT NUMBER
06-R-06

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Air Force Packaging Technology and Engineering Facility (AFPTEF) was tasked with the design of a new shipping and storage container for the C-17 Fan Thrust Reverser (FTR) in March of 2004. The new container is designed to replace the wood crate and wood frame assembly presently used. The current containers' lack of mechanical protection, environmental protection, handling issues, and left and right container requirements prompted AFPTEF's design of a new container. The new container will protect the FTR both mechanically and environmentally, hold either the left or right FTR, and make it easier to maneuver during worldwide shipment and storage. The CNU-688/E, designed to SAE ARP1967A, is an aluminum, long-life, controlled breathing, reusable shipping and storage container. The new container passed all qualification tests per ASTM D4169. The CNU-688/E container not only meets users' requirements but will also provide an economic saving for the Air Force. The savings will be thousands of dollars over the twenty-year life span of the container.

15. SUBJECT TERMS

CNU-688/E, C-17 Fan Thrust Reverser Container, C-17 FTR Container, Aluminum Container, Reusable Container, Design, Test, Long-Life

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Robbin L. Miller
U	U	U	UU	55	19b. TELEPHONE NUMBER *(Include area code)* (937) 257-3362

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